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CONTENTS.

Editorial 457
Patent Office Scandal 462
"Break Down" Service in New York 462
Signals and Automatic Train Stops in the Hudson Tunnels 463
President Roosevelt on Monopoly of Water Powers 463
Minnesota Central Station Men Organize 464
Electric Lighting in Cities and Villages of 3000 Inhabitants and Under 464
New York Electrical Society 465
Argument on Light and Power Rates at Minneapolis 465
Printing Telegraph at U. S. Capitol 466
Kelvin and Submarine Telegraphy 466
Motor Equipment of the Bethlehem Steel Company's Rail and Structural Mills 469
Single-Phase Railway in Virginia 471
Comparative Tests of Different Types of Electric Fans. By Arthur C. Scott 473
Direct-Current Motors, Their Action and Control.—V. By F. B. Crocker and M. Arendt 476
Electrical Exhibit in a Providence Department Store 477
Testing Electric Meters at Their Place of Installation.—I. By Joseph B. Baker 478
Data on Elevator Service from Dayton, Ohio 480
Electric Pumping from Deep Wells 480
Electric Service of the Fitchburg Gas & Electric Company. By William H. Stuart 481
Electric Power, Its Progress and Possibilities. By A. H. Kimball 483
Electrical Equipment of an Iron Foundry 486
The Electric Motor Load from the View Point of Central Station Service. By Charles K. Nichols 486
Electric Refrigeration in a Meat Market. By R. L. Lloyd 489
Central-Stations and Electric-Motor Applications 490
Power Requirements of Machine Tools 493
A New Field for Electric Power. By George H. Jones 495
Electric Elevator Service. By R. S. Hale and R. H. Gray 495
Blow-Off Valves for Steam Boilers. By R. T. Strohm 495
Suggestions for Obtaining New Motor Business. By Norman G. Meade 504
The Steam Laundry—A Promising Field for the Sale of Electrical Energy 507
Lancaster (Pa.) Central-Station Display Room 509
The New System of Rates at St. Louis 509
LETTER TO THE EDITORS:
Chimneyless House. By Cortlandt de P. Field 510
Digest of Current Electrical Literature 510
New Industrial Apparatus 515-525
Fan Motors for 1908 525-530

ELECTRIC POWER LOAD.

The contents of this issue are largely devoted to power application from central-station circuits—a subject which is rapidly becoming of such vital importance to central-station managers as to demand their best thought and most energetic action. It is true that the value of a motor load to a central station has always been recognized, but the tendency in the past has been to regard it so far secondary to the lighting load as only to call for odds and ends of attention, if any at all. These remarks do not apply, of course, to the case of most of our large city plants, as the economic study by these of every branch of electrical supply early led to an appreciation of the necessity of a day load in order to make operation profitable. What can, however, be done in smaller cities and towns by persistent effort is illustrated by the examples of Fitchburg, Mass., and Marion, Ind. In the first-mentioned place, of which the central-station plant and its business methods are the subject of the two articles printed elsewhere in this issue, almost 60 different applications of electric power have been made, and this in a community of less than 50,000 inhabitants; and in Marion, a relatively small town, every industry is dependent upon the electric motor, which evidence of modernity is one of the points dwelt upon in the publicity campaign carried on by the city to swell its manufacturing industries.

As pointed out by Mr. Kimball in his account of building up the Fitchburg power load, success in this line cannot be expected to attend immediately upon effort put forth. Among the reasons for this are the vague ideas users have as to the amount of power actually expended in the operations of their plant, and the equally vague ideas as to the actual cost to them of steam power. If a small manufacturer has a steam plant rated at, say, 10 horse-power, he assumes that he is using just about that amount of power during the entire working period; and as this class has rarely any system for keeping account of power costs, their rough-and-ready estimates of these neglect important items, such as the large ones of steam plant depreciation, repairs and interest on investment, and many smaller ones that are not obtrusively evident. It is not an easy task to disabuse the minds of the average proprietor on these points and bring him around in favor of electric power by argument alone; for such argument to be effective implied the preliminary instruction of the subject in steam costs and the mysteries of kilowatts, average demand and other matters of a kind with which his mind has not been accustomed to deal. The most successful plan appears to be the installation of motors on trial, and getting on the ground immediately after a breakdown with a neighborly offer to install immediately an electric motor to keep the plant going. With a motor once installed, and with a power rate that is reasonable, there is little proba-

bility of a return to the former power, and the effect on further business of each new motor placed will be of a geometric order.

The field for household applications of electric power has as yet been practically untouched, and is most promising. For example, the electric fan has become as much a summer necessity for the office as ice water, and the time is not distant when this will also be the case in the household. There is here no inertia to use to be overcome; for if once installed, a suggestion from the head of the family to cut it out will be apt to bring the ready reply that economy in this respect might first be applied at the office desk. Central-station preparations for the coming summer season should include a large stock of electric fans for placing out on trial, the term of which should be made somewhat indefinite in order that a final answer as to purchase may be called for at a time when the temperature will have some influence on the decision. The great success in putting out flat-irons on trial should be duplicated by similar electric-fan campaigns. Other most promising motor applications is to the washing machine, which is important on account of possible indirect effect with respect to further uses of electricity. The great domestic issue now confronting the American people is the servant question, and in this electricity can be made to figure as a considerable ameliorating factor on account of the many household conveniences it has to offer. We venture to say that in many communities the introduction and successful use of several electric washers would quickly place this application on a good footing, and that in time servants would give the preference to the household which in this manner has mitigated her hardest task. The relatively small use of electricity in the household aside from lighting, has been due more to inertia on the part of central stations than chargeable to the general public. The social history of the past half century has shown that there is scarcely any limit to the desire of modern people for conveniences that make life easier. At present, the dweller of the tenement house enjoys sanitary conveniences that were a luxury to the wealthy less than a generation ago; and the general introduction of the bath-tub was a matter of less ease than should be the passing into general use of most of the numerous electrical household appliances described in other pages of this issue.

Electrical Manufacturing Costs.

It is understood that the General Electric Company's production of apparatus for the year ended Jan. 31 reached the splendid total of $70,000,000, as compared with $60,000,000 in the previous year. While the report will not be due until May, these figures may be accepted as approximately correct. It is estimated, however, that the amount available for dividends was $9,800,000, as compared with $10,232,839 in 1903 on a gross of $36,685,000, or about one-half the product value. In other words, in spite of the tremendous advance in the value of the product, the per cent of profit to gross has fallen off in the period 1903-8 from 28 to 14 per cent.

This is an extremely interesting result, and raises many conjectures, but we think it is susceptible of various explanations that are generally of an encouraging nature. First of all, it seems part of a general or universal tendency observable throughout the field of industry, and to be noticeable almost invariably as periods of great prosperity climax. Expenses mount up rapidly in such times, but prices do not rise with them, or do it more slowly as the element of competition comes in and other checks are automatically imposed. In some instances prices of goods have advanced sharply, but for the period named it is probably true that electrical prices have relatively and actually declined. This would be due to the fact, as a broad proposition, that the size of the unit has gone up, bringing with it an actual smaller return on the piece, or on the horse-power or kilowatt capacity.

But electrical manufacturing has had to endure during the past five years a scarcity of labor which was increasingly inefficient as it was better paid, if one is to believe the statements made. It was frequently impossible to get the skilled labor needed, and even whole classes were taken out of college at the moment of graduation. Now there are more normal conditions, and the showing will probably be better. The most obvious point is that the cost of one item of raw material, copper, had gone up enormously, and even taking it for granted that electrical manufacturers did not at any time pay the utmost high price, they certainly had to pay a good deal more than now, when open quotations of copper are around 13 cents. This reduction of copper cost will necessarily show in the value of output, and it would seem likely to have a decided influence in bringing the per cent of profit on gross back to the old basis, or near it. There are involved also other questions and considerations, such as the effect of patents on protecting large profits of manufacture. Possibly this element did not enter any more in 1903 than it does in 1908, but it is a reasonable assumption based on facts that profits are usually high where the patents are strong and enforced; it being the wise object of the patent system to encourage the investment of capital in new inventions. Electrical inventions were never so free as they are to-day from controlling patents.

Tests of Desk Fans.

Everyone is familiar with the modern electric desk-fan. It comes into evidence when the thermometer climbs each year into the middle of that part of the scale lying between the marks "temperate" and "blood heat." Long before our office thermometers have reached the mark of intemperate blood heat (98.6 deg. Fahr. or 37 deg. C.) the office fans are at full speed The fan load on a summer day in a large city like New York is a very respectable aggregate for the central stations, and helps to level the load diagram and increase the load factor. During the summer, the swish of every desk fan is a sigh of care lifted from the station manager's heart. The comparative tests of seven different fans, which form the subject of an article appearing in this number, are specially welcome in view of the meagre existing data in this branch of design. All of the fans tested—and probably the samples represent the great bulk of the articles furnished on the market—had a total fan diameter of from 11.5 in. to 12.4 in., or so nearly alike in this respect that they would have to be set side by side to make the difference in diameter clearly distinguishable. Moreover, all fans seem to be divided into four blades. Comparing the direct with the alternating-current fans, we observe from the tables in the article that the mean direct running current is 0.42 ampere, and the mean alternating running current is 0.73 ampere,

or about 75 per cent more; but the mean direct-current watts are 46.7 and the mean alternating-current watts 50.6, or about 8 per cent more. In regard to power consumption, the two types are therefore on the average not far apart, although the differences in power consumption among different alternating-current makes are much larger than among the different direct-current makes. Moreover, just as in larger motors, the alternating-current fans take on the average a much larger starting current, namely, 1.75 amperes, as against 0.71 ampere for the direct-current starting average.

It is not clear from the article what "net watts" may mean; but assuming that they mean the power delivered in each case to the blades at full speed, it appears that the mean motor efficiency of the direct-current machines was 43.4 per cent and of the alternating-current machines 29 per cent. In this comparison lies the weakest part of the latter fan, because it is not so much the waste of a watt or two more in the motor that is objectionable, but rather the warmth thereby given to the air that is blown into one's face. Like the hand-fans of Cleopatra's attendants, before the days of the electric fan, they glow the faces they do wave; or, according to Shakespeare, "what they undid, did." It is certainly undesirable to cool a man by blowing warmed air into his face. The article indicates that the average temperature elevation of the direct-current motor frames was 5.5 deg. C., and that of the alternating-current motor frames 11.3 deg. C., or nearly twice as much. Of course, it is easier to criticise than to correct, because the iron losses tend to be greater in the alternating-current motors. Some compensation for the greater warmth of the alternating-current motors is, however, found in the fact that with the exception of the series type, they have no commutators to get into possible trouble, and to that extent are preferable to direct-current motors.

A fan enjoys the property of increasing in resisting torque as the square of the velocity, up to the particular velocity at which it begins markedly to slip through the air or to churn air without displacing it. Assuming that we work below this velocity, a given amount of power put into the blades is exchanged into motion of translation, and into motion of twisting or eddies in the air. The former is the useful motion in fan-moved air. It is theoretically possible either to move a larger volume of air at a smaller average velocity, or a smaller volume of air at a larger average velocity. Neglecting eddy-current motion, a certain quantity of power in watts at the blades exchanges for a definite total quantity of $mv^2/2$ or kinetic energy in air. As a rule, people prefer a fan that gives a fairly large m or mass of air in motion, and a more moderate average velocity v. This means a fan that will distribute air generously in different directions or spread the motion out fanwise, rather than one which sends a concentrated small jet along the axis at a high velocity. Of course, a self-centered man, who thinks only of his own desk, may prefer a thin jet of air at high velocity; but a friendly spirited altruistic person, especially if he catches cold easily, likes to see the beam of air distributed impartially upon the just and unjust, with a large and generous m but correspondingly diminished v^2. The velocity diagrams accompanying the paper are an interesting innovation, and ought to be developed further for different speeds of each fan. It would be convenient to have a polar velocity-curve supplied with each fan by the maker, like the polar candle-power curve of a lamp reflector.

LOCAL CONDITIONS AND BUSINESS-GETTING.

How far do local conditions commonly influence the obtaining of new business by central station companies? We have been treated to a variety of answers to this question during the past two years. It is, of course, common for the central station manager who has not been making the most of his field to hide behind the local-condition excuse and maintain that his town is different from many others. In fact, this was invariably the argument which was brought up for many years to block attempts at progress in central station commercial development. There are those who maintain that there is no radical difference between American communities in the possibilities which they offer for central station revenue, and that the differences of local conditions talked of are largely imaginary, or that the little differences offset each other in different communities. It must be confessed that the supporters of this doctrine have a long record of successful demonstration back of them to prove that in a large number of cities and towns there is no great difference in the possibilities. On the other hand, there are every now and then examples which may or may not be the exceptions which prove the rule, but which certainly seem to show that there are some nuts which are very hard to crack.

We have known of cases where central station solicitors and new-business men after a brilliant record in one community have failed dismally in another. It is true that a solicitor with a successful record in one community, upon being transplanted to another community as a prize business-getter, may have such inflated ideas of his personal importance as to prevent him from making another record. This does not account for all of these cases, however. There is undoubtedly considerable difference in the rapidity with which different communities will take up innovations, and in the freedom with which they will spend money. As a general thing, the community which will take up new things most rapidly is the one which will drop them the soonest. It may take many times the work in solicitation to introduce new electric appliances into a frugal, saving community of retired farmers than in a mining town, where money flows freely. Once introduced, however, these appliances are likely to remain in use, and there will be no great slump in earnings when hard times strike the place, as there would be in the mining community. We think it must be recognized that there is considerable difference in communities as regards central station growth, although this difference is nowhere near as marked as some conservatives would have us believe, and we have yet to hear of the town which has not yielded increased central station revenue under the right kind of effort.

MOTORS FOR DOMESTIC WATER PUMPING.

The electric motor is assuming an important place in making up for the shortcomings or absence of water-works supply in numerous places. In some large cities the water service is so inadequate and poorly planned that insufficient pressure is a chronic condition, and all large flat and apartment buildings have to depend on their own pumps for the supply of the upper

floors. This makes good business for the central-station company, even though it may be a reflection on the municipally-operated water works. Nothing is so well adapted to domestic pumping service of this kind as the electric motor with automatic starting and stopping apparatus. It can be used either with or without a roof storage tank. In small towns where there is no water-works system there is always the opportunity to install small electric pumps for the hotels, business houses and larger residences. In this way the absence of the possibility of a city pumping load for the central station is partly made up for by the small individual pump installations.

Electric Deep-Well Pumping.

The question of the best method of adapting electric motors to deep-well pumping comes up frequently in cases where the electrical operation of small waterworks systems is under consideration. As an assistance to the central station manager in considering the efficiency and desirability of the various methods of deep-well pumping, the abstract of the paper by Mr. Charles B. Burdick before the Western Society of Engineers, which appears elsewhere in this issue, will be found of value. The depth of the water below the surface necessarily has much to do with the plan to be adopted. Probably the most efficient deep-well pumping by electrical means at the present day is by vertical-shaft centrifugal pumps sunk in the well to below water level, as indicated in the paper referred to. Such an arrangement, however, is the most expensive to install of the three methods available. The air lift has never had any great claims for economy made for it, but it certainly eliminates much of the uncertainty of service and expense of repairs to apparatus which operates deep in a well, because all of the moving machinery is entirely outside of the well. Assuming that a central station company is able to do all of its pumping from a well at times when it has ample engine and generator capacity, the question of the inefficiency of the air lift in a small central station need not cause much concern. If the air compressor is operated either by a belt from an engine used to drive a generator, or by a motor from the generator, it will usually cause a surprisingly small incease in the coal consumption. The reason for this is that many of the fixed losses in the engine and boiler plant are so large on light loads that a small addition to the load does not make a proportionate increase in the coal bill. As to deep-well plunger pumps, there is very little to be said in their favor, from the standpoint of a central station company about to pump water from a deep well electrically. To begin with, the question of properly counterbalancing them is serious. If this is not taken care of thoroughly the variations in load on the motor at different parts of the stroke will cause voltage variations on the small central station, and these variations may become of such a frequency as to be very annoying. Add to this the prospect of troubles in hauling up and repairing the deep-well plunger, and the choice seems to simmer down to air lift versus vertical-shaft centrifugal pump. If there is much water to be pumped and the reaming out of the well can be done at a reasonable cost the centrifugal pump is to be chosen on account of its economy. In a small plant, where it is desirable to keep the investment down, the air compressor, which can so easily be adapted either to motor or engine drive, has strong claims for recognition.

Motors and Defective Heating Systems.

An interesting article by Mr. George H. Jones, elsewhere in this issue, calls attention to the new and extensive field for small electric motors in overcoming the defects in steam-heating systems in large buildings where low-pressure steam-heating plants are in use. The attention of central-station men has already been called to the important part which the small fan motor may take in improving and curing the defects of hot-air furnace-heating systems. It is also well known to the profit of central-station companies, motor manufacturers and pump manufacturers that the electric motor has an important part to play in making up for the shortcomings of city water supply in flats and apartment buildings where electrically driven pumps must be used to insure satisfactory water pressure. It now appears that the "motor cure" can be taken to advantage by steam-heating plants, the motor in this case being used to run a small pump to return water of condensation to the boilers and to insure drainage of the condensed water from the steam-piping system of the building. The owner of an apartment building in which there is trouble from the collection of condensed water in the pipes seems to have heretofore been between the two horns of a dilemma. If the boiler pressure were raised, coal bills were likely to go up in proportion, because of unnecessary radiation losses at various points.

If, on the other hand, a steam pump were put in to aid in draining pipes and returning condensed water to the boilers, the boiler pressure would have to be run up considerably above that needed for heating the building in order to operate the steam pump. Besides that, the pump itself under such conditions, exhausting into the atmosphere, is a very wasteful piece of machinery. A small electric motor and centrifugal pump, according to the practical experience cited in Mr. Jones' article, is a much more economical proposition for the building owner than either the steam pump or increase in steam pressure without the pump. With the motor-driven pump, low steam pressures can be carried and the electrical energy required by the pump is a very small item. It is likely that investigation would reveal thousands of steam-heated buildings which might be more satisfactorily heated by looking after the return of condensed water to the boilers and drainage of the pipes. In the case of a small low-pressure plant, this can best be accomplished by the electric motor.

The St. Louis Rate System.

The rate system recently adopted by the central-station company at St. Louis, details of which are given elsewhere in this issue, differs sufficiently from other typical systems of rates in extensive use in the United States to entitle it to special mention in a class by itself. The fundamental principle underlying the St. Louis system is that a customer shall be given a lower rate the higher the minimum guarantee he is willing to make per month per lamp connected. Besides this, the rate is graded according to the amount of a customer's connected load, thus recognizing the principle that it is in some respects cheaper to serve one large customer than several small ones. These two principles, that of the minimum guarantee and the amount of

connected load, govern the customer's base rate, and upon this basic rate further discounts are given according to the number of hours' use per month of the connected load and also according to the amount of the customer's bill. The discounts allowed for energy consumed in excess of a certain number of hours' use per month of the connected load is not, however, as large as is customary in rate systems where this principle is recognized. In fact, it would be out of the question under the St. Louis system to make that discount charge in view of all the other discounts to which the customer may be entitled. The most unusual and striking thing about the system is the grading of the basic rate according to the minimum guarantee which the customer is willing to make per month per lamp or per horse-power connected. The idea is a striking one in several respects. The customer has an inducement at the outset to make his minimum monthly guarantee as high as his business will stand in order to get the benefit of the lower kw-hour rate which the high guarantee carries with it. There is, of course, for every customer a balancing point, where the minimum guarantee will equal the bill rendered for energy consumed, and it is about this point that the intelligent customer will attempt to fix his guarantee. The same principle has been applied extensively in measured-service telephone rates. One of its principal practical advantages seems to be that it overcomes the customer's objections to paying high minimum bills. The customer has laid before him a rate schedule whereby he can select his rate per kw-hour by guaranteeing a greater or less minimum bill. It aids in making clear to him the justice of high minimum bills for customers having small kw-hour consumption. It also tends to induce customers who have established a certain minimum bill to consume energy fully up to the minimum, as there is no incentive to economize if the energy consumption is to fall below the minimum.

Right to Regulate Rates.

Note has been made of the unanimous decision of the New York Court of Appeals in the case of the Saratoga Gas Company, holding that as a successor to the former commission, the Public Service Commission has the constitutional right to regulate prices. The old Gas Commission is held to have had such a right, and the new commissions inherit it. There seems to be, however, some misunderstanding as to the real nature of the decision even in that respect. It was held that a maximum rate might be fixed by a body enjoying the delegated legislative powers, but it was likewise held by the court as unconstitutional that the lighting companies should not enjoy or possess the right and opportunity to secure an increase in any rate that the conditions proved to be unreasonable. The lower courts had held that in such respect the companies had no status. The highest court has reversed this as unconstitutional, in denying to the companies equal protection under the law. In other words, a Public Service Commission does not exist merely to cut down prices in the interest of the consumer, but must accord to a company equally the right to apply for a change in its favor. This is only fair, but even some of the members of these commissions seem to have assumed or taken it for granted that their sole mission and object in life was to act on applications against the companies and even to work up complaints against them. It has been our view, and the court now declares that to be the true constitutional fact, that such commissions must not be partisans or prejudiced, but have been created to protect the corporations equally with the consumer, who naturally wants to get a commodity as cheaply as he can. That is human nature, but is not always human equity or divine law.

Electric Power for Vacuum Cleaning.

Vacuum-cleaning apparatus for household use, which has been rapidly on the increase during the past two years, is of interest to central-station men as offering additional opportunities for day load. One can now find on the market apparatus all the way from a light, portable apparatus weighing only 70 lb., using a ⅛-hp motor and costing about $125, up to large stationary plants employing motors from 5 horse-power up, and costing many hundreds of dollars. The machines range all the way from those producing a very small vacuum and moving a considerable volume of air up to others maintaining 15-in. vacuum, which will pull the dust clear through an ordinary rug. The noisy portable gasoline engine-driven automobile or wagon outfit which goes from house to house in our large cities has already become a familiar sight. In large hotels stationary motor-driven outfits have become common. It is to the more extensive use of the smaller apparatus, however, that the central-station man must look for the most important revenue. The smaller machines are rather new on the market as yet, and it is difficult to predict how extensively they will be used. It is not unreasonable to suppose that if once a rug is thoroughly cleaned it can be kept clean thereafter by frequent applications of light suction, and for miscellaneous dusting low vacuum is well suited. There thus should be a good field for the small, portable apparatus which can be used in every house where electric service is available. It is also possible that where individual householders do not feel like purchasing an apparatus, a house-to-house business in a neighborhood might be done by one man with a very small capital at prices which would make regular patronage of such a service attractive. The fixed charges on some of the larger gasoline-driven wagon outfits are high because of their great first cost, and the operating cost is also high because of the number of men required to go with them. If house-to-house work with small outfits is ever successful, it must necessarily be on the basis of more frequent visits and at moderate cost. When vacuum cleaning comes to be the common method in residences and high-class offices, there will be a notable increase in central-station revenue.

It would seem that among the most promising fields for electrically-operated vacuum-cleaning systems is that of apartment and flat buildings. The piping of such a building in a manner to have a tap for every apartment is not relatively a very important item of expense, since a few risers can take care of a large number of apartments. In such a case, one good outfit can take care of the cleaning of a large number of families, and the wiring can easily be so arranged that the motor can be started by a switch in any one of the apartments, the current used by the motor being registered by a meter for that apartment. Such an arrangement should prove a very popular feature in any apartment building, since the question of cleaning of rugs and curtains becomes more serious the more congested the city and the larger the buildings.

Patent Office Scandal.

On Thursday, Feb. 27, an indictment was filed in the Supreme Court of the District of Columbia, against Examiner Ned. W. Barton, of the U. S. Patent Office, John A. Heany, of York, Pa., and the patent attorney of the latter, Henry E. Everding, of Philadelphia, in which it is charged that they "unlawfully and wilfully and with intent to steal and destroy the same, did take and carry away from the said Patent Office" certain specifications and an amendment thereto, and a letter relating thereto, the date of the offence being Sept. 2, 1907. The specifications were filed with, and formed part of, an application, No. 241,782, filed Jan. 19, 1905; the amendment was filed on July 27, 1907; the letter, which was addressed to John A. Heany and signed by W. A. Cowles, acting examiner of the patent office, and bore the stamp of Commissioner F. I. Allen, was dated March 28, 1905. Those charged with the crime were arrested and held on $10,000 bail, which was furnished.

The patent involved is apparently one bearing date of issue of Dec. 3, 1907, and relating to tungsten-filaments and electrodes for incandescent lamps. According to the newspaper accounts, applications from a large number of electrical concerns have been in interference with the Heany application upon which the patent is based, and the changes alleged were made to secure a patent that would be superior to any granted on these applications. The evidence presented to the Secretary of the Interior is stated to have been obtained by detectives in the employ of one of the large electrical manufacturing companies.

In a statement relating to the case, Patent Commissioner E. B. Moore said that early in February evidence was laid before the Secretary of the Interior, tending to show that fraudulent acts had been committed in the prosecution and procurement of a patent. The secretary at once brought the matter to the attention of the Commissioner of Patents, who immediately appointed a committee of investigation. This committee found in substance that by the connivance of an employee of the Patent Office, matter that was not in the application for a certain patent at date of filing was unlawfully introduced subsequently during its prosecution, thereby laying a foundation for claims to an invention not disclosed in the application when it was filed. The effect of such an act is to establish a false date of invention much earlier than the true date and thus enable the patentee to dominate and control all inventions falling within the scope of the claims of his patent that were made after the filing date of the application for that patent, even though in fact they may have been made earlier than the invention covered by his claims.

The specific charge, Commissioner Moore said, is that of destroying public records. It is alleged that Barton, by reason of his position, had access to office records, and was enabled, at a very recent date, to substitute for papers filed more than two years previously, certain other papers and give them the same date as if they had been filed originally. The invention described in the substitute papers is thought to be very valuable, and a great advantage would attend it if a date of invention sufficiently early to antedate the prior inventions of others could be secured. To be successful in this plan it was necessary to destroy original records of the office, and file substitutes therefor, and by changing the dates of receiving stamps make it appear that such substitute papers were, in fact, actually filed upon the fictitious dates stamped on the papers.

Commissioner Moore added that notwithstanding the vast moneyed interests involved in patents and the consequent many opportunities for corruption arising therefrom and from the necessity of relying upon the integrity of each individual examiner, owing to the technical and judicial character of the work of the patent office, no examiner has ever been shown false hitherto to the trust imposed upon him in all the 118 years of existence of the United States patent system.

Several patents have been granted to Mr. Heany on metallic-lamp filaments. The latest of these is dated Dec. 3, 1907, an account of which appeared in these columns shortly after its issue. The application for this patent, No. 241,782, was filed Jan. 19, 1905. On an application, No. 239,769, filed Dec. 29, 1904, by the same inventor, a patent was issued Dec. 25, 1906, and on Jan. 29, 1907, a patent was issued to him on application No. 238,769. Accounts of these patents also appeared in our columns. In the specifications of the patent of Dec. 3 a number of other applications on file relating to tungsten-filaments are referred to.

No statement from any of the parties involved in this regrettable scandal has been obtainable; and in view of the previous good standing of those indicted, there should be a suspension of judgment until their side of the case is presented.

"Breakdown" Service in New York.

"Breakdown Service" was the issue discussed last Wednesday before Public Service Commissioner Maltbie at the first hearing in the investigation of electric light companies in New York. Mr. Arthur Williams, general inspector of the New York Edison Company, after giving a definition of "breakdown service" stated under what conditions the Edison Company had been giving such service to consumers in New York. On the books of the company were 123 private plants, Mr. Williams said, which were supplied with this service during the year ending December 31, 1907, using a total of 3,504,961 kw-hours. During 1907 no new contracts were made for such service, except at the request of the Public Service Commission. Mr. Williams testified that the Edison Company had ceased giving this class of service about two years ago, because at that time the increase in the demand for "breakdown service" became so great that the company felt that to comply with all requests would seriously affect the general system. The matter of giving "breakdown service" had never been formulated as a policy of the company, and it was feared that the taking over of large plants of 1000 or 2000 horse-power would seriously interfere with the operation of the entire system. Additional reasons were the large maintenance cost and impracticability from an engineering standpoint, of providing feeders, mains, meters and service, all of which must be installed up to 100 per cent of "breakdown" contracts, for private plants. The 123 consumers who were already on the books of the company were supplied at the best rate of the company for that class of service.

Referring to a recent letter of the Edison Company to the Commission, offering to furnish "breakdown service" to all applicants on a minimum charge of $30 a year per kilowatt of installation, Mr. Williams said that this price was estimated on the basis of the average return which the company was getting from its service to all its customers. He gave $300 to $400 as a fair average cost of installing a distributing and generating system per kw-capacity.

Mr. John W. Lieb, Jr., third vice-president of the Edison Company, said he felt that the "breakdown service" charge, in view of the fixed and stand-by expenses incurred by the company, was a fair and equitable rate, both from the company's standpoint and the standpoint of the consumer. He testified that the ordinary consumer required about 30 to 35 per cent of his connected capacity, but that the company found it necessary to be prepared to supply between 60 and 75 per cent of the installation capacity of a consumer who was using the "breakdown service." "On certain occasions," said Mr. Lieb, "when we felt that the public in general would suffer, we have not allowed anything to stand in the way of making prompt and immediate connections with a company which requested a 'breakdown' connection."

Mr. W. W. Freeman, vice-president of the Edison Electric Illuminating Company of Brooklyn, testified that his company had never refused to give "breakdown service," subject to certain restrictions and conditions. The charge made by the Brooklyn Company for this class of service was the same as that made to other consumers, except with a minimum rate of $1 per year for each 16-cp lamp, which equals $20 a year per kilowatt. Each month the consumer received his bill, and if, at the end

of the year the amount of the aggregate bills was less than the minimum charge, the consumer was required to pay the difference. The $20 rate had been established in the early history of the company, and had been fixed in accordance with the custom of other companies. The matter of computing the cost of "breakdown" installation, Mr. Freeman said, had never been investigated until recently, by the Brooklyn Edison Company, but in the last two weeks the question has been taken up, and it was found that, according to averages, each kilowatt of such connected installation cost the Brooklyn company $21.50 per annum to carry; so that any sum received less than this amount from the consumer would not carry the actual fixed charges. The demand on the system, Mr. Freeman testified, was for the last year close to 50 per cent of the total connected installation.

None of the other companies which appeared before the Commission had been furnishing the "breakdown service" to consumers, and after the various representatives had testified to this effect, the hearing was adjourned until Monday, March 2.

Commissioner Maltbie on the date set for the second sitting of the commission adjourned the hearing until Thursday, March 6, when "breakdown service" will come up for further consideration. Only the Brooklyn Edison Illuminating Company, the United Electric Company and the New York Edison Company will be required to appear before the commissioner on that date.

Signals and Automatic Train Stops in the Hudson Tunnels.

An excellent example of the latest practice in block-signaling, interlocking and automatic train stopping is afforded in the equipment of the recently opened tunnels of the Hudson & Manhattan Railroad under the Hudson River.

The installation comprises a complete automatic block-signal and automatic train-stopping system, covering all of the tracks between Nineteenth Street, New York, and Hoboken, N. J. Between Hoboken and Greenwich Avenue—the river section of the tunnels—signals are placed on an average of 367 ft. apart. The minimum distance where speed is low is 115 ft., and the maximum is 1620 ft. On steam railroads, block-signal sections average 2640 ft., or two signals per mile; on the express tracks of the New York Subway the distance is 800 ft., or nearly seven signals per mile. In the Hudson tunnels the signal distance is only 367 ft.—or more than fourteen signals per mile.

The signals give three indications: "proceed," indicated by green light; "proceed with caution," yellow light; "stop," red light. As the consequences of a train passing a signal in the "stop" position may be disastrous, a device for automatically stopping such train is used at each signal. This consists of two movable short arms or trips placed alongside each rail. When the signal is in the "stop" position these arms are raised to engage with the trigger of a valve in the air-brake pipe of the train, releasing the air and setting the brakes. Each car is equipped with two of these valves—one on each end and on opposite sides of the car. When the signal moves again to the "proceed" position, the electric motor moves these train-stop arms out of "stop" position, thus permitting the train to pass without setting the brakes, the arms being returned to stop position by gravity after the train has entered the block. This automatic method of train control is in successful use on the Boston Elevated Railroad and on the New York Subway express tracks. On these lines, however, only one automatic stop is used to protect a train. In the Hudson tunnels, two stops are used, thus insuring a greater measure of protection.

An important feature of the system is that both rails of each track are used for the train propulsion current and also for the signal current. This arrangement permits of broken rail protection—that is, a broken track rail will interrupt the circuit and so cause the display of a "stop" or red signal, and the operation of the automatic stop if the "stop" signal be displayed.

All of the switches are under the control of the interlocking devices, consisting of seven plants—one at the Hoboken Terminal (the largest), two at Caisson No. 1, two at Caisson No. 2, one at Greenwich Avenue, and one at Nineteenth Street. The interlocking is by the All-Electric system—the switches being operated by electric motors at each switch. The signals are of the same type as used in the block system, and are controlled from the machines, the levers of which are so interlocked that it is possible to make only such movements as have been previously arranged for; conflicting movements are in this manner absolutely guarded against.

An interesting and novel feature of this plant is the illuminated track diagram. This is a diagram or chart of each track layout painted on glass and placed in front of each machine for the information of the operator. Each line of track has a row of small electric lamps placed back of the glass; these lamps are controlled from the different track sections; when the tracks are unoccupied the lamps show a bright green light; as soon as a train enters the limits of the interlocking, the light controlled by the track on which the train is running is extinguished, so that movement of a train along the track can be followed by observing the corresponding movement of the dark space along the track on the diagram. Without this method of indicating train movements it would be difficult for the operator to follow closely the train movements, on account of his limited field of vision, due to the construction of the tunnels.

The signal system was furnished by the General Railway Signal Company, of Rochester, New York and Chicago. The automatic stopping system was furnished by the Kinsman Block System Company, of New York.

President Roosevelt on Monopoly of Water Powers.

In a message sent to Congress Feb. 26 by President Roosevelt, transmitting a preliminary report of the Inland Waterways Commission, that part of the report dealing with water powers is commented on at some length. At present, President Roosevelt says, "among the monopolies there is no other which threatens or has ever threatened such intolerable interference with the daily life of the people as the consolidation of companies controlling water power. I call your special attention to the attempt of the power corporations, through bills introduced in the present session, to escape from the possibility of government regulation in the interests of the people. These bills are intended to enable the corporations to take possession in perpetuity of national forest lands for the purposes of their business, where and as they please, wholly without compensation to the public. Yet the effect of granting such privileges, taken together with rights already acquired under State laws, would be to give away properties of enormous value. Through lack of foresight we have formed the habit of granting without compensation extremely valuable rights amounting to monopolies on navigable streams and on the public domain. The repurchase at great expense of water rights thus carelessly given away without return has already begun in the East, and before long will be necessary in the West also. No rights involving water power should be granted to any corporations in perpetuity, but only for a length of time sufficient to allow them to conduct their business profitably. A reasonable charge should of course be made for valuable rights and privileges which they obtain from the national government. The values for which this charge is made will ultimately, through the natural growth and orderly development of our population and industries, reach enormous amounts. A fair share of the increase should be safeguarded for the benefit of the people, from whose labor it springs. The proceeds thus secured, after the cost of administration and improvement has been met, should naturally be devoted to the development of our inland waterways. . . . Running water is a most valuable natural asset of the people, and there is urgent need for conserving it for navigation, for power, for irrigation and for domestic and municipal supply."

Minnesota Central-Station Men Organize.

Managers of 25 central-station companies and municipal electric-light plants met at Hotel Nicollet, Minneapolis, Feb. 28 and 29, 1908, and organized the Minnesota Electrical Association. The first to move in the matter of organizing a Minnesota association of this kind were Mr. E. E. Rines, a consulting engineer and salesman, of Minneapolis, and Mr. A. H. Lane, of the Glencoe, Minn., central-station company. These issued the call and made the preliminary arrangements for the meeting. At the first session, Mr. A. H. Lane, of Glencoe, was elected temporary chairman, and Mr. Thomas Pitts, of Hutchinson, temporary secretary. Mr. Lane gave an address outlining the benefits of forming a central-station men's association. He was followed by Mr. Rines, who stated some of the work he thought should be attempted by the association. There was then a general discussion of the question whether the membership should be confined to companies or extended to municipal plants. It was finally decided to take in both companies and municipal plant men, as a number of superintendents of municipal plants were present, and it was felt that it would be beneficial for all to meet together.

A committee to draft a constitution and by-laws was appointed to report next day. This consisted of Messrs. R. E. Brown, of Mankato; W. R. Putnam, of Red Wing; Ludwig Kemper, of Albert Lea; A. J. Wagner, of New Ulm, and Leonard Peterson, of Thief River Falls. A committee to nominate officers was also appointed, consisting of Messrs. E. F. Strong, of Chaska; A. L. Westphal, of Staples; B. W. Copperthwait, of Fairbault; Emil Eveldson, of Litchfield, and A. V. Schroeder, of Winona.

The constitution, as adopted next day, provides that the membership shall be vested in central-station companies and in superintendents of municipally owned plants in Minnesota. The annual dues, which include the initiation fee, are $5. The annual convention is to be held the third week in March, the place to be fixed by the executive committee. Electrical manufacturers, dealers and consulting engineers are eligible to associate membership at $5 per year.

Various matters were discussed in an informal way, among other things the desirability of having electric-light companies regulated by a state commission as in Massachusetts, New York and Wisconsin, with competent experts to deal with central-station matters instead of uninformed and frequently dishonest city councils. It seemed to be the consensus of opinion of both municipal and corporation plant managers that regulation by a good commission was very desirable and that since such a commission was likely to be adopted in Minnesota before many years, it was to be welcomed.

A part of one session was given to the explanation of recent new developments by various manufacturers and jobbers. Friday evening the convention was entertained by a dinner at Hotel Nicollet, after which there was a theater party. This was tendered by the following Minneapolis manufacturers, jobbers and supply men: Northern Electrical Company, Minneapolis Steel & Machinery Company, Electrical Machinery Company, Minneapolis Electric Motor Company, R. M. Laird, Hollis Electric Company, Columbia Incandescent Lamp Company, Bryan-Marsh Company, G. J. Caldwell & Company, Walter Geisse, Twin City Electric Company, General Electric Company, Electrical Engineering Company, St. Paul Electric Company, and H. L. Upton.

When the convention adjourned, Saturday noon, it was taken to St. Paul on a special car by the Northwestern Electrical Equipment Company and entertained at luncheon at Hotel Ryan, which was followed by a matinée theater party.

The officers elected are: Mr. W. R. Putnam, of Red Wing, president; Mr. A. H. Lane, of Glencoe, first vice-president; Mr. Leonard Peterson, of Thief River Falls, second vice-president; Mr. Ludwig Kemper, of Albert Lea, secretary and treasurer. Messrs. R. E. Brown, of Mankato; Adolphus G. Wagner, of New Ulm, and T. C. Gordon, of Little Falls, together with the president and secretary, form the executive committee. The officers are a well-chosen body of the active central-station men of the state. Considering the small number of central stations in Minnesota, an attendance of 25 at a preliminary meeting of this kind is remarkably large, and the Minnesota Electrical Association starts in with prospects for a vigorous and useful career.

Electric Lighting in Cities and Villages of 3000 Inhabitants and Under.

At the recent convention of the Northwestern Electrical Association, Mr. Irving P. Lord, the general manager of the Waupaca Electric Light & Railway Company, of Waupaca, Wis., presented a paper with the above title, in which he said that during the past 10 years the number of commercial electric light plants has increased in a wonderful degree, and that this progress seems unabated. There are many small villages of less than a thousand inhabitants that are now lighted by electricity, whereas a few years ago such was not the case. Recent inventions and electrical machinery development have made it possible to invest as meager a sum as $5,000 in an electric-light plant in some small village, and obtain satisfactory returns. This is especially true where water power is available, or where the steam power of some manufacturing plant can be utilized. The demand for electricity keeps pace with general progress, and as rapidly as its production can be made to result in dividends on the required investment, so certain will new plants be built. This condition is to be desired by electrical manufacturers and supply houses for obvious reasons, and it should be their pleasure to encourage it.

Mr. Lord, having been actively interested for some years in the electric lighting business in a small city, and having observed an increase of income from $6,000 the eighth year to more than double that amount the sixteenth year, with no material increase in population, is convinced that there are possibilities in the electric lighting field, even in places having a population of 3000 and under. In these small plants the owner is manager, bookkeeper, collector, auditor, solicitor and purchasing agent. He employs a practical, competent electrician, who, with such help as is necessary, sees that the station is properly kept, and the general line work and inside wiring satisfactorily done. If the owner is ordinarily capable and keeps abreast of the times by regularly reading the electrical journals and attending his state association meetings, he will soon acquire such a knowledge of the business as is necessary to have in order to make it a success.

Another source from which the owner can get much practical knowledge is from the traveling salesmen who will frequently honor him with a call. They come in contact with many different propositions in their travels, and have perplexing questions presented to them almost daily, and it is no wonder they are often able to make suggestions that are valuable to the owner of a small plant, especially if he is new to the business. The acquaintance and friendship of the traveling salesman representing reputable houses should, therefore, be cultivated.

A small owner should acquire the soliciting habit. Assuming that his plant is in good physical condition he must then get the business. A reasonable rate for energy should be established, and as to what is a reasonable rate, local conditions will largely govern. It should be remembered that it is always easier to reduce rates than to advance them. The acquaintance and friendship of the merchants, manufacturers and others who might need considerable energy should be sought. Pleasant argument with these men when they are not busy is productive of good results. Technical terms should be avoided when talking with them, and if energy is sold at 10 cents per kw-hour, they should be told that a 16-cp lamp will consume approximately six-tenths of a cent's worth of electricity in an hour of time, and an 8-cp lamp a little more than half as much. Prospective customers can better understand such statements. One should not dis-

pute the statement, if made, that kerosene or gasoline is cheaper than electricity; but should convince the person making it that neither is as good, convenient or healthy. It has been Mr. Lord's experience that of those who have been induced to try electricity only a very small number will ever cease to use it.

Dwelling-house lighting is profitable and the use of heating devices should be encouraged. Flat-irons when installed at cost will almost sell themselves after a 30 days' trial. They are usually consuming energy when the load is the lightest, and the income they produce is practically clear gain.

Street lighting in small cities and villages is usually a perplexing feature of the electric-light business. The aldermen or board of trustees are seldom composed of the best business talent of the place. They have their own personal interests at stake more than those of the muncipality they are supposed to serve. They think it quite the proper thing to be against the electric light company and they base their prospects of a re-election upon the vigor with which they have opposed the company and its business. Petty jealousies and personalities enter into their deliberations when they act upon an application of some citizen for a new street lamp, and it is often the case that no lamp is installed no matter how badly it is needed.

It is unwise to get into altercations with the aldermen or trustees. They should be treated with common business courtesy and all semblance of interest as to whether they put in new street lamps or not should be avoided. In due time they will find out that it is the public and not the electric light company that is seeking the new street lamps and the installation will soon be ordered.

One thing that is sadly lacking in the operation of small electric lighting plants is system. The business seems to be run too much on the country-store plan, which is really no plan at all. Very imperfect accounts are kept and the operation, construction and maintenance accounts are kept and the operation, construction and maintenance accounts are all so jumbled together that an expert accountant would have hard work untangling them. Many small owners have carried on their business for years without any definite knowledge at the end of the year as to just what the financial condition of the plant is. It is not necessary to have such a detailed system as many of the larger companies have, but it is absolutely necessary to have some system. Almost any practical bookkeeper can devise a system that will furnish the desired information at all times. A separate account should be kept with each customer, showing what his monthly bill is for energy, supplies or labor. It is a source of satisfaction for the owner to compare these monthly accounts with those of previous years, and by showing a prospective customer just what it has cost Mr. Blank to light his store during the year, another customer may possibly be obtained.

In concluding, Mr. Lord impressed upon those to whom his paper is especially addressed the necessity of trying to keep up to date in their business. He suggested that there was no better way of doing this than by mingling with others similarly engaged, exchanging ideas, comparing notes, making inspections of other plants, regularly attending the annual meetings of the state association and coming in contact with those who knew more than he did, listening to the papers and discussions there presented and visiting the exhibits and demonstrations provided by manufacturers and supply men. The small investment necessary to do this will be found to be one of the very best investments of the year.

New York Electrical Society.

Five hundred of the members and friends of the New York Electrical Society were present at the 274th meeting of the society in the Engineering Societies' Building on Feb. 28, when a most entertaining lecture was given by Mr. Augustus Post, the well-known aeronaut, on "Navigating the Air." Mr. Post treated his subject under two heads: apparatus lighter than air, and apparatus heavier than air. The former class was subdivided into balloons or gas bags, both free and captive, without motor, and envelopes or gas bags with motor. The heavier-than-air class was subdivided into aeroplanes, including kites, and gliding machines without and with motive power, and machines of the helicopter and ornithopter types. The helicopters are direct lift machines using propellers or other devices for pulling them into the air and supporting them there while other propellers or kindred devices cause them to move forward, or the machine itself is so tilted that the supporting propellers are pulling at an angle in the direction in which progress is desired. Ornithopters are bird-like, flapping wing machines, a form of progression which as hitherto developed is difficult and inefficient.

A practical illustration of an ascension was given by the inflation of a model balloon, perfect in every detail, loaned by Mr. Albert C. Tridca, director of the International School of Aeronautics, which was made to ascend in the lecture hall. The incident was made more interesting by the unfurling of the Stars and Stripes as the balloon left its moorings, to the distant strains of the "Red, White and Blue."

The latest signal development in ballooning, the international Gordon Bennett races at St. Louis, were described, and many striking episodes of the races were illustrated on the screen in a series of moving pictures, showing the inflation of the enormous bags under the direction of a special detachment of the U. S. Signal Corps, the start, the ascension, and the shrinking of the receding balloon to a mere speck in the sky.

A series of interesting slides was shown by Mr. Wilbur R. Kimball and a large number of pictures were loaned for the occasion by the Aero Club and by Mr. W. J. Hammer.

Argument on Light and Power Rates at Minneapolis.

On Feb. 25 the Minneapolis General Electric Company and the committee of the Minneapolis City Council came to an agreement on electric light and power rates, which will probably mean the early drafting and acceptance of an ordinance giving the company a 30-years' franchise and fixing the rates for electric light and power for the first year of the franchise. The matter has been in controversy over a year, and has brought out interesting points and helped to establish valuable precedents.

The City Council first passed an ordinance requiring a uniform rate of 8 cents per kw-hour, with discounts purely according to quantity. The company refused to recognize this ordinance on the ground that it was unjust, inequitable and confiscatory. It offered instead, as it had in the past, rates based on the number of hours' use per month of the connected load. The rates now agreed upon by the company and Council committee are based on the sound principles of rate-making for which the company has contended, although the company yielded to the committee's ideas on some points. The point of notable interest to electric-light companies in this controversy is that a company has been able to convince a council committee and citizens of the fairness of a rate based on load factor, and of the unfairness of a uniform rate per kw-hour for all classes of business. This was done largely by expert testimony and investigation. Extended mention of this case has already been made in these columns, and more will be said in a later issue.

The accepted residence lighting rate is 9 cents per kw-hour for the first 52 hours' use per month, of 40 per cent of the connected load, and 6.66 cents for all over that. Commercial lighting is at the same rate, except that the maximum demand as measured by maximum-demand meters is substituted for 40 per cent of the connected load. Minimum bills are $1 per month per lighting customer. Retail power is to pay 7.5 cents per kw-hour for the first 52 hours per month of the customer's maximum demand, and 2.5 cents for all over that. The minimum bill is $1 per month per horse-power connected. The chief

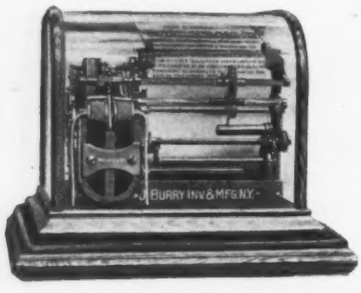
difference between these and the old rates of the company is that the maximum rate has been reduced on lighting from 12.6 cents for 52 hours' use of 60 per cent of the connected lamps to 9 cents for 40 per cent; and the minimum bill on power reduced from $2 to $1 per horse-power. Free incandescent lamp renewals and free arc-lamp maintenance have been abolished under the new rates. Quantity discounts from 5 to 25 per cent are to be allowed on sums from $50 to $250 per month.

It was agreed by the experts that the maximum rates are below the profitable point as regards many small customers, and they were accepted as the equivalent of a franchise tax levied on the company in the interests of small consumers.

Printing Telegraph at U. S. Capitol.

A printing telegraph service, to report instantaneously in distant committee rooms and offices the proceedings on the floors of the Senate and House of Representatives, has been installed at the Capitol at Washington, and is now in operation on a demonstration basis. The system used is the Burry "page-printing telegraph," which prints the message, not like a "stock ticker" on a narrow tape, but line after line on a paper ribbon about 5½ in. wide.

The present installation consists of a single transmitting station in the basement of the House of Representatives end of the Capitol, and of a receiving instrument, which is placed in the distant southeast corner of the new House of Representatives Office Building, adjoining the Capitol. As the latter building is several minutes' brisk walk from the House, even when one uses the new subway that connects these buildings, this installation gives a good demonstration of the value of the service in disseminating information as to what is going on in either chamber of the national legislature, for the convenience



RECEIVING INSTRUMENT.

of Senators and Representatives in the committee rooms or in their private offices. An advantageous feature of the plan is that it provides a record of the proceedings, so that a congressman arriving late at the Capitol can tell at a glance what has occurred.

The system is operated over a two-wire metallic circuit, the current being supplied from the 115-volt electric-light circuit of the building, the voltage being cut down by resistances. Although for the present only two stations are working, it is said that any reasonable number of receiving stations may be operated from one transmitter; and should the system be adopted by the government, it is proposed to have two transmitting stations—for reporting the proceedings of the Senate and the House, respectively—and a number of receivers located at the most effective points throughout the Capitol and the two new office buildings. The speed, for a heavily loaded line, is said to be 30 words per minute.

The transmission of official business was begun upon the convening of the House, Feb. 20, under arrangement with the House Journal Clerk.* The following are the principal features of the system:

The type wheel has 36 characters, but is controlled by an escapement-wheel having only half that number of teeth. This design means increased speed, since the type-wheel has to rotate through half the arc, on the average, that it would otherwise have to traverse. To print a given character, the received electric impulses actuate a polarized relay controlling the escapement-wheel thereby rotating the type-wheel into a position, with reference to the platen, midway between two characters of which one is to be printed. The selecting impulse from the sending keyboard then shifts the type-wheel forward or backward, by means of an aligning star-wheel on the same shaft as the escapement- and type-wheel, through one-seventy-second of a revolution, thereby presenting the right character to the platen for the printing stroke.

The receiving instrument is also equipped with a "momentum-wheel" spring winding device, consisting of a heavy brass wheel having teeth milled on its edge. These teeth are engaged by a "pumping ratchet" by which every mechanical impulse given by the functioning of the "power magnet" of the instrument, due to the received electric impulses, drives the wheel ahead. The teeth are also engaged by a detent, which prevents backward rotation of the wheel. The latter, thus continually urged ahead by the operation of the instrument mechanism, maintains the tension in a spiral spring which is threaded on the shaft of the wheel and which serves as a source of power for releasing the type-wheel escapement and shifting the paper. This device advantageously replaces the weight wound over a drum that is often used in apparatus of this kind as the source of power for operating the mechanism. An ingenious friction contact between the momentum-wheel shaft and the spring, obtained by winding the latter on a taper arbor, serves to prevent "over winding."

*"The Burry Page-Printing Telegraph," *Scientific American*, p. 181, March 23, 1901.

Kelvin and Submarine Telegraphy.

Prof. W. E. Ayrton, who was a student under Sir William Thomson, at Glasgow, contributes a lengthy and highly appreciative letter to the engineering supplement of London *Times*, with the title "Kelvin in the Sixties." From this we print below the portion which treats more particularly with Kelvin's connection with the development of the submarine telegraph:

During the sixties the world was very much interested in the possibilities of an Atlantic cable. In 1857 cable had broken while being laid; the 1858 one had failed after one short month of existence; the 1865 cable snapped after 1186 miles had been laid, and, although nine days were spent in trying to pick it up, and, although it was grappled many times, the rope broke; and this cable, like its predecessors, had to be abandoned. A few yards of this 1865 cable that had been picked up lay on the floor of the Glasgow laboratory and was often pointed to by Thomson as being what had given them heart and kept off despair. Then a prize of over three-quarters of a million sterling was offered to the Telegraph Construction & Maintenance Company if they could complete the 1865 cable and lay an 1866 one. And they won it.

While it was remaining doubtful whether the two sides of the Atlantic would ever be coupled electrically, Thomson's secretary used not unfrequently to be sent to the Glasgow rail station a few minutes before the mail train started with this urgent message from Thomson: "I have gone to White's to hurry on an instrument. The London mail train must on no account start to-night until I come." And such was the national importance of the problem, and such the honor in which Thomson was held, that the station-master obeyed.

Many have used Thomson's reflecting galvanometer and have regarded it merely as an extremely sensitive galvanometer without knowing how it came into existence. It was devised by Thomson to enable him to utilize his mathematical solution of signaling through a long submarine cable, and was regarded of such national importance that a private Act of Parliament was sanctioned by the Privy Council to extend the normal life of 14 years for the patent of this cable "speaking instrument," as it was originally called. The invention of this instrument marks the theoretical solution of a most important problem, which

solution Thomson found great difficulty in getting the electricians of that day to accept.

As early as 1855—before any long submarine cable had been constructed—Thomson published in the *Proceedings* of the Royal Society the theory of the propagation of signals through a cable based on a correspondence which he had had with the late Sir Gabriel Stokes, and he showed that the book "Fourier de la Chaleur"—that "mathematical poem," as he used to call it—contained, in Fourier's mathematical equations of the flow of heat, the entire mathematical solution of the propagation of electric waves through a cable. From "Fourier's series" he deduced that, whereas on a short overhead telegraph line the signal reaches its full strength at the distant end practically as soon as the signaler at the near end of the line begins to send it, with a submarine cable it is retarded, spreads out, and blurs the next signal. There is a past history effect as in politics and in many natural phenomena. The passing of an Act of Parliament cannot suddenly change a people; indeed, it is well known that the actual effect of an Act of Parliament promoted by well-wishers is often gradually found to be most harmful, and has to be repealed or curbed in its action.

Herbert Spencer in his "Sociology" strongly advocated legislators to study the science of politics. Thomson would perhaps have said "Study Fourier's mathematical poem."

If it were attempted to send a series of electrical signals through an Atlantic cable with the *same* apparatus and at the *same* speed as messages are sent between London and Brighton, the signaler at the far end would not have the slightest knowledge that the signaler at this end was trying to send a message, whatever were the strength of the current sent into the cable. To work a long submarine cable, either time must be allowed for each signal to grow at the distant end, or, as this would make the sending of the message very slow, the receiving instrument and the signaler receiving the message must, like a clever doctor diagnosing a disease, be able to interpret mere indications. Sending the letter "e," for example, produces at the other end of a long cable a totally different result, depending on what has preceded it. In no case, at a speed of, say, 30 words a minute with a 3000-mile cable, will it be more than a suggestion, even at the beginning of a word; but in the syllables "toe" the "e" is as indistinct as the hurriedly written scrawl that you are very glad to get some one else to read for you.

Thomson wanted a receiving instrument which, unlike the ordinary telegraph instruments used in postoffices and railway stations, could render the interpretation of such suggestions possible in the hands of an expert signaler, and he devised the mirror galvanometer speaking instrument to obtain this result.

Another most important fact that his theoretical investigation brought out was that no increase of battery power could counteract the retardation in the signals produced by any impurity existing in the copper conductor of a cable, and hence that every yard of copper wire used in the thousands of miles of a long cable must be electrically tested before being used.

But all this appeared to the electricians as arising from the ignorance of an inexperienced young man who had never erected a mile of telegraph line in his life, and would not have been given a job in any telegraph office. And so when signals through the 1858 Atlantic cable became weak, and a message from the President to our Queen took 30 hours in transmission, although containing only 150 words and which would need only three or four minutes to transmit through any one of the good Atlantic cables of to-day, the only remedy of those who looked down on the theories of the young Glasgow professor was to use Whitehouse's "thunder pump," a magneto-electric machine which produced a sudden large e. m. f. when the armature of the permanent magnet was jerked off the poles of the magnet. But these shocks only sent sparks through the gutta-percha insulating coating and hurried the poor cable to its doom, so that even the three words per minute which would have been the utmost limit of speed possible had this cable been entirely uninjured, were replaced by absolute silence.

But Thomson energetically struggled on and pursuing (as he told me afterward) a "Parnell-Biggar policy" at the board meetings of the Atlantic Cable Company, obstructed all business until the directors promised to have all the copper wire tested for resistance before being made into cable; and thanks to Thomson for his theory of signaling, to that engineer of energy and surprising resource, even when quite a lad, Sir Charles Bright, to Captain Anderson, of the *Great Eastern*, and to all those who have followed in the history of submarine cable development the London Stock Exchange is by cable to-day within 30 seconds of Wall Street.

Thomson's work in connection with submarine telegraphy has been epoch-making. But 33 years ago it was associated with what I felt was a national loss. I give in an extract from a long letter which he wrote to me in Japan, December, 1874: "My dear Ayrton—You will be very sorry to learn of the terrible loss which has befallen us in the loss of *La Plata*, cable ship, with my nephew, David King, on board. * * *" David King and I had worked together for Thomson. I had seen them much in company with one another. In appearance, independence of thought, and in many ways there was great resemblance between them, so that I used to hope that a corner of the mantle of William Thomson might rest on David King.

Thomson has been called an engineer. In creative power, yes—a great engineer. But not in the forties, nay, even in the sixties, could a university student either at London, Glasgow or Cambridge learn what to-day is called even a college engineer. Thomson had never learned to make a working drawing, he designed in metal. We students could not help him with the T-square and drawing board as we might have done had we received the college engineering training of to-day. He thought of a new instrument, a new method of accomplishing some result flashed on him, and he sketched in his pocketbook a rough indication of what he wanted constructed; I took the idea, or what I understood of it, in my head to Messrs. White, so it was not to be wondered at that alteration after alteration was necessary before the thing that was in Thomson's mind's-eye became realized in metal.

CURRENT NEWS AND NOTES.

OMAHA ELECTRICAL SHOW.—An electrical show will be held at the Auditorium, Omaha, Neb., from April 13 to April 18.

OHIO INDEPENDENT TELEPHONE ASSOCIATION.—The annual convention of the Ohio Independent Telephone Association will be held at Hotel Hartman, Columbus, Ohio, Thursday, March 19.

NO GIFTS FROM CHICAGO PUBLIC-UTILITY COMPANIES.—Comptroller Wilson, of Chicago, has ruled that no telephone, traction, electric light or other public utility corporation can make contributions to hospitals or other charities.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION.—The annual meeting of the Missouri Independent Telephone Association will be held in Kansas City, Mo., Wednesday and Thursday, May 6 and 7. One of the features of the meeting will be a session for the discussion of farm mutual telephone service. The association has now nine district organizations, at all of which meetings will be held in advance of the annual general meeting. Mr. G. W. Schweer, of Windsor, is secretary of the association.

GOVERNMENT TELEPHONE IN BRITISH NORTHWEST.—At a meeting of the Canadian Bell Telephone Company, held at Montreal Feb. 27, it was announced that in all probability the company will sell out its business to the Provinces of Saskatchewan and Alberta. It is stated that while the company did not desire to sell, it was thought best to do so rather than incur the risks of competition with government lines in these provinces. The telephone system in Manitoba is already under government ownership.

NEEDHAM (MASS.) MUNICIPAL PLANT SOLD.—The town of Needham, Mass., has sold its municipal electric-lighting plant to the Boston Edison Illuminating Company and has closed a long-term contract with that company for street lighting.

ELECTRICAL INSPECTION IN CINCINNATI.—An ordiance has been enacted by the City Council providing for an inspection department for gas and electric meters. An inspector is to be appointed by the Board of Public Service at a salary of $2,000 per year.

CENTRAL STATION DINNER.—The Rockford, Ill., Edison Company gave on Feb. 20 a dinner to the "allied electrical interests of Rockford." According to the handsome menu of the occasion, a similar dinner will be given annually, the purpose being to "Boost for a brighter, bigger, busier Rockford."

ARC WIRELESS SYSTEM.—The German Patent Office, in a case of interference between Ruhmer and Poulsen, has awarded priority to the former for a device which has been used in the Poulsen system for interrupting the arc used in the production of Hertzian waves in wireless telegraphy and telephony.

NEBRASKA ELECTRICAL ASSOCIATION.—The annual meeting of the Nebraska Electrical Association will be held in Omaha during the week of the Omaha Electrical Show, May 4 to 9. Mr. William Bradford, of Lincoln, is secretary of the association, and Mr. L. E. Watson, of Beatrice, chairman of the program committee.

ILLUMINATING ENGINEERING SOCIETY.—At a meeting of the New York Section of the Illuminating Engineering Society, to be held in the United Engineering Societies Building, Thursday evening, March 12, at 8.15 o'clock, Mr. E. L. Elliott will present a paper on the "Relation of Illuminating Engineering to Architecture from the Engineer's Standpoint."

M. A. C. ENGINEERING SOCIETY.—The students in the electrical, civil and mechanical engineering courses of the Michigan Agricultural College, East Lansing, Mich., have organized an engineering society, and weekly meetings will be held for the presentation and discussion of papers. As far as possible, the papers will be obtained from members of the faculty and graduates engaged in engineering work.

BIDWELL IN COURT.—Benson Bidwell and his son, Charles F. Bidwell, were summoned in two court proceedings at Chicago on Feb. 18, one under a charge of operating a confidence game and obtaining money under false pretences in connection with the Bidwell Electric Company, and the other in an action for bankruptcy. It was stated at the time that another charge would be brought against the Bidwells for using the mails to defraud. Last week one of the cases came up in a Chicago court, but was adjourned by the judge owing to the evident illness of Benson Bidwell upon his appearance in court. W. H. Davidson, formerly export manager of the Bidwell Electric Company, stated that the Bidwells kept their "cold" motor, when exhibited, covered with ice by pumping carbonic acid gas through pipes which were cast in the outer framework of the machinery. According to the Chicago *Record-Herald*, Charles F. Bidwell, the son of Benson Bidwell, admitted that his father is a brother of the late Austin Bidwell, of the Bank of England notoriety.

NEW YORK STEINWAY TUNNEL.—The Interborough Rapid Transit Company has offered to sell to New York City the Steinway Tunnel under the East River for cost, which is stated to be $7,239,476. The tunnel is now completed, but the company has not received permission from the city for its operation. Accompanying this offer is a suggestion that if the city purchases the tunnel a contract be entered into with the New York & Queens County Electric Railway to operate the tunnel for a period of 25 years, a single fare of five cents to be charged between the New York terminal and any point on the line of the Queens County Electric Railway.

UNDERWRITERS AND WIRE COMPANIES CONFER.—Following the announcement made last week that the Underwriters' Laboratories, Chicago, had withdrawn its affiliation with the Wire Inspection Bureau and that the Underwriters would refuse to accept the reports of that Bureau after Feb. 29, extended conferences were held in New York during the latter part of last week between a committee representing the Underwriters and a committee representing the wire companies. Until the committees have reported back to their respective organizations the results of their conferences will not be disclosed, but it is stated that a basis for the readjustment of the differences between the two bodies may be reached and the former relations of the Underwriters with the Wire Inspection Bureau resumed.

TRIBUTE TO THE LATE GEN. EUGENE GRIFFIN.—At the annual reunion of the First Volunteer Regiment of Engineers, of which the late Gen. Eugene Griffin was colonel during the Spanish War, Major Louis Duncan offered the following tribute to the memory of his former commander: "We knew the strength of his patriotism and his feeling of stern devotion to duty, and we knew the delicacy and tenderness of his friendship. In him was no small or ignoble thought. Whether we who are here believe in any creed, or whether our souls are shrouded in the gloom of disbelief, this we know: that somewhere in the illimitable confines of space we shall meet him again. God judges His people outside of creeds or beliefs. Eugene Griffin was a good man, and no harm can happen to a good man, whether he be alive or dead."

MARSEILLES ELECTRICAL EXPOSITION.—The American honorary committee for this French exposition, to be held this summer, has just been announced and includes in the electrical field Messrs. H. G. Stott, B. J. Arnold, C. F. Brush, J. J. Carty, M. Coster, F. B. Crocker, Lee de Forest, Carl Hering, P. C. Hewitt, Samuel Insall, H. Ward Leonard, J. W. Lieb, Jr., C. O. Mailloux, T. C. Martin, R. W. Pope, H. N. Potter, C. P. Steinmetz, L. B. Stillwell, Frank J. Sprague, Elihu Thomson, W. H. Tolman, S. S. Wheeler, and W. J. Wilgus. American exhibits now have until June 1 to get in place at the exposition, which opens April 19, and the classification has been slightly amended and enlarged. The electrical congress in connection with the exposition will be held Sept. 14 to 21. The program will be announced shortly, and will emphasize power transmission and distribution. Mr. Paul Dieny is the commissioner for the United States, Park Row Building, from whom data, rules and regulations can be obtained.

PUBLIC HEARING ON ACCOUNTING.—Commissioner Maltbie, of the Public Service Commission, announces that a public hearing will be held early in March on the subject of electric light accounting. For some time past the accounting committee of the Empire State Gas & Electric Association has been holding conferences with similar committees of the National Electric Light Association, the American Gas Institute, the Street Railway Association and the statisticians of the Public Service Commissions of both the first and second districts. A classification has been prepared by the committee which in many respects has met with the approval of the statisticians of the commission. Several important points, however, are still under discussion before the final adoption of a classification by the commission, which shall be used by all the companies of the state. Under the law the Public Service Commission has the power to decide upon a uniform system of accounting which shall be used by all the gas and electric companies.

Motor Equipment of the Bethlehem Steel Company's Rail and Structural Mills.

THE most severe and trying duty for electric motors is that of driving the reversing tables, transfer tables, screw-downs and other heavy machinery in steel and rolling mills. The frequent starting and stopping, heavy overloads and sudden reversals, subject the motor to strains that are not met with in any other class of service. Some idea of the unusual character of the load can be obtained by reference to the accompanying curves, in which the peaks are caused by sudden reversal.

Railway service was for a long time considered very severe for motors. Yet even in electric railway service the starting and stopping of motors are infrequent compared with the starting and stopping of motors in rolling mill service. Reversal of rotation is seldom necessary, and overloads are the exception rather than the rule. Perhaps in rough handling and exposure of motors to dirt alone can railway service be compared in severity to rolling mill service.

Because the series railway motor was the most rugged type on the market, it was natural that this type of machine should have been used when a motor was required for rolling mill work. Owing to the greater severity of work, however, added to inadaptability of various points of the design, railway motors never proved entirely satisfactory.

One of the shortcomings of railway motors for rolling mill service was that they were designed for 550 volts. Their commutators were therefore too small to take care of the increased current for 230 volts satisfactorily, and for this reason were a source of trouble. In addition to very poor commutation on 230 volts, rolling mill engineers urged the following objections to railway motors for this work: The shocks to which they were subjected in railway work are taken up by springs, and the shafts are therefore not heavy enough when the motors are without this protection. The frames in motors of considerable size are not split. Moreover, the frame is so compact that the parts are not accessible and no room is available for shunt or compound field winding. Further, they are designed for grease lubrication only; they cannot be securely bolted to foundations, owing to the absence of proper feet; and they have other objectionable features. It was therefore seen that in order to make a satisfactory motor for rolling mill work it would be necessary to design one specially for that work, regardless of previous types.

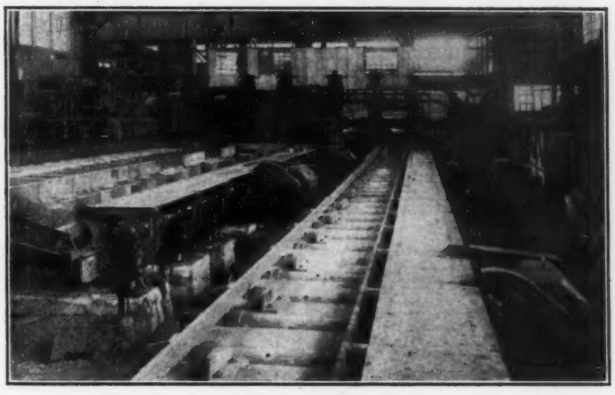


FIG. 1.—MOTORS OPERATING RAIL-MILL REVERSING TABLES.

The Sancon plant of the Bethlehem Steel Company at South Bethlehem, Pa., is equipped with motors of the rolling-mill type. The plant is one of the most thoroughly equipped in the country, and is probably the first designed and constructed with a view to using electrical drive wherever possible. While motors have been used in steel mills for light machinery, it is only recently that they have been employed to drive the tables, screw-downs and do heavy work. Notwithstanding that the older types of motors were not rugged enough for the work, the advantages of electric drive were so obvious that it is but natural that a new type of motor especially suited for this very important class of work should be forthcoming.

The motors in use at South Bethlehem are of the Crocker-Wheeler make, and were designed after consultation with leading mill engineers to meet the following electrical requirements: The motor must be designed primarily for 230 volts. Commutation must be such that sudden reversals and sudden and extreme overloads will not injure the commutator or produce undue heating. The insulation must be of such character that it will not deteriorate with heat. Shunt field winding must be provided in nearly all cases in addition to the series field winding to prevent racing. Finally, the motor must have tremendous starting torque.

FIG. 3.—MOTOR-DRIVEN HOT SAWS.

The mechanical requirements were as follows: The frame must be of such design that it can be securely bolted down. The shaft must be of very large diameter, as all the extreme jars and shocks must be taken up in the bearings and not by springs. The frame must be split and readily separable, so that the armature can be instantly removed and replaced in case of injury to the shaft or windings. The armature must be of comparatively small diameter to avoid danger from high speeds and to minimize the inertia and facilitate sudden starting, stopping and reversal. The armature winding must be retained by means that will not give way under extreme heat. The shaft must be readily replaced. The journal boxes must prevent the escape of oil and the admission of dust. Means for lubrication must be provided. All parts must be readily accessible without disassembling the motor. In general, every part must be extremely strong and durable, fastened in such a way that no amount of vibration will loosen or dislodge it, yet readily replaceable at will. Parts must be interchangeable.

Outside of driving the rolls themselves, for which duty a special arrangement of motors and circuits is necessary, the

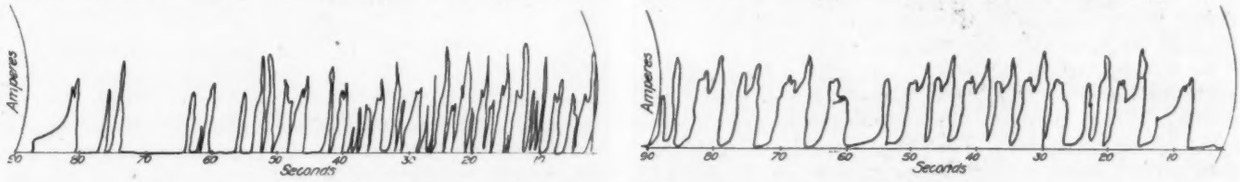


FIG. 2.—CURVES SHOWING CURRENT TAKEN BY ROLLING-MILL MOTORS.

hardest duty in rolling mill service is that on the motors driving the reversing tables of the blooming and shaping mills. Here the motor is called upon to reverse the ingot as many

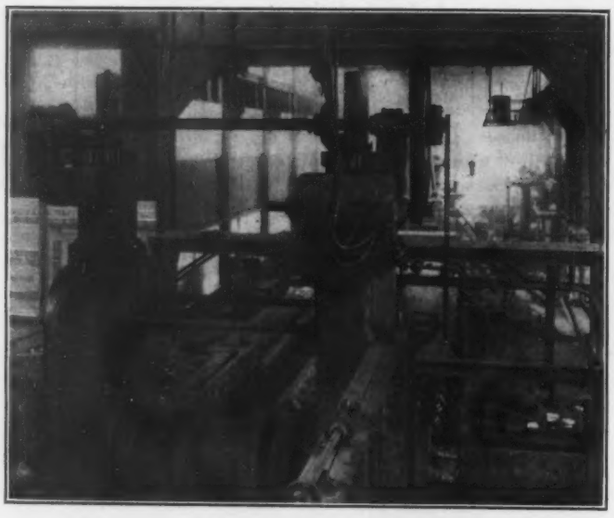


FIG. 4.—MOTOR OPERATING SCREW-DOWN OF BLOOMING MILL.

as 10 or even 12 times in a minute with practically no rest between reversals and very short rest between heats. This is well shown in curve, Fig. 2. Next in severity probably comes the duty on the screw-down of rolls. This is a duty for which railway motors were never used. Transfer tables, loaders, shears and shear tables, saw tables, small tools and other machinery each have load characteristics putting peculiar strains on the motor.

A view of the rail mill of the Bethlehem Steel Company is shown in Fig. 1. In this mill the billets are deposited on a motor-operated table which delivers them to electrically-driven reversing tables. On the latter tables the billets go through

FIG. 5.—MOTOR EQUIPPED WITH MAGNETIC BRAKE ON SCREW-DOWN OF 40-IN. BLOOMING MILL.

five passes and are then delivered to another motor-driven table, from which they pass to still another table. They pass thence to the reversing tables of the intermediate stand, and after going through seven passes, are transferred to the reversing tables of the finishing rolls. The view shows the arrangement of four of the motors.

The rails are carried on motor-driven tables to the hot saws,

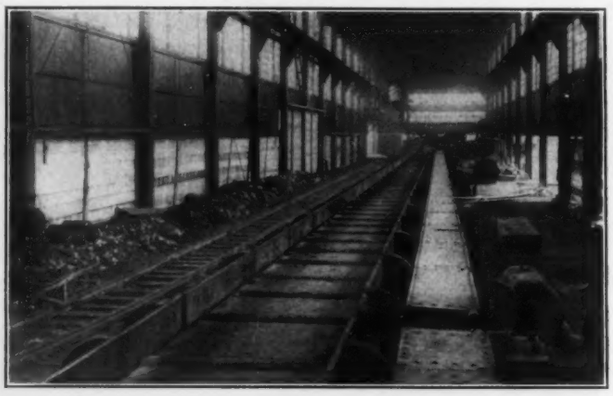


FIG. 6.—MOTOR-DRIVEN TRANSFER TABLES IN GREY MILL.

where they are cut into standard lengths. Fig. 3 shows a number of these saws, each of which is driven by a 45-hp, open-type

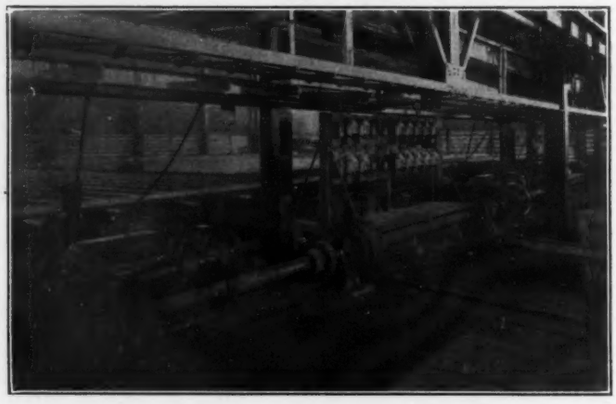


FIG. 7.—PULL-ON, RAKE-OFF AND TRANSFER TABLES OF HOT BEDS.

motor. One of the rolling-mill motors is also shown in Fig. 3, operating the transfer table. When structural shapes are being

FIG. 8.—MOTORS DRIVING PULL-ON, RAKE-OFF AND TRANSFER TABLES OF GREY MILL HOT BEDS.

rolled, a motor-driven, sliding-frame, hot saw is used instead of the drop type saw shown. After being cut into proper lengths, the rails are transferred to a hot-bed table driven by two motors. The pull-on and rake-off are each operated by

seven motors, and the delivery table of the hot beds is driven by two motors.

The screw-down mechanism on the blooming intermediate and finishing mills is also operated by motors. A 75-hp motor is provided for the screw-downs of the 40-in. blooming mill, and Fig. 4 shows the motor-operated screw-down on a 46-in. blooming mill of the Grey structural plant. In the latter mill the various units are arranged in line, and not side by side, as in the rail mill. The intermediate and finishing mills are provided with two motors for the screw-downs, and the reversing and transfer tables are electrically operated. The hot saw is driven by a 225-hp motor. A view in the Grey mill (Fig. 6) shows three 50-hp motors driving transfer tables.

The arrangement of the hot-bed motors is shown in Fig. 8, which illustrates the pull-on, rake-off and table motors in the Grey mill. The motors are controlled by the magnetic controllers of the Electric Controller & Supply Company. About 20 of the motors for the 28-in. structural mill are equipped with induction couplings of the Wheeling Mold & Foundry Company. There are 120 motors in use having an aggregate rating of 6000 horse-power.

Single-Phase Railway in Virginia.

The single-phase equipment of the Richmond & Chesapeake Bay Railway, which was outlined in our issue for June 16, 1906, is now in successful operation. The road extends from Richmond to Ashland, a distance of 14.8 miles. Energy for operating the cars is obtained from special generating apparatus installed in the Twelfth Street station of the Virginia Passenger & Power Company, where two 750-kw, 25-cycle generators are directly connected to hydraulic turbines; one of these generators is arranged also to be driven by a 60-cycle, three-phase motor, and the other by a direct-current motor. The energy is transmitted from this station for about 1.6 miles through lead-covered cables to the Richmond terminal at 6600 volts, which is the same e.m.f as used on the trolley. The trolley wire is of No. 4 copper, suspended from a ⅜-in. steel messenger cable.

At present the rolling stock consists of four motor cars. The electrical equipment of each car consists of four 125-hp General Electric series-repulsion 603-A single-phase motors, similar to those in use on the Washington, Baltimore & Annapolis, as noted in our issue for Feb. 15, 1908. The multiple-unit type of control is employed. There are two oil-cooled auto-transformers (sometimes called "compensators") on each car, each transformer being provided with taps to give 600, 450, 400, 340, 280 and 113 volts. The apparatus is arranged and installed in such a manner that each pair of motors and its auto-transformer, together with the respective contactors, etc., form an equipment which is practically independent of the other two motors and auto-transformers, etc. This arrangement has the great advantage that, should a motor or pair of motors, or an auto-transformer, or, in fact, any piece of apparatus constituting part of the equipment become damaged or defective by an accident or from any other cause, the car can be operated

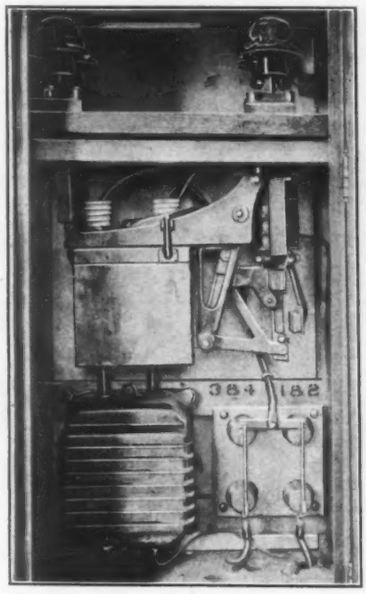


FIG. 2.—PARTIAL VIEW OF APPARATUS IN HIGH-TENSION CABINET ON CAR.

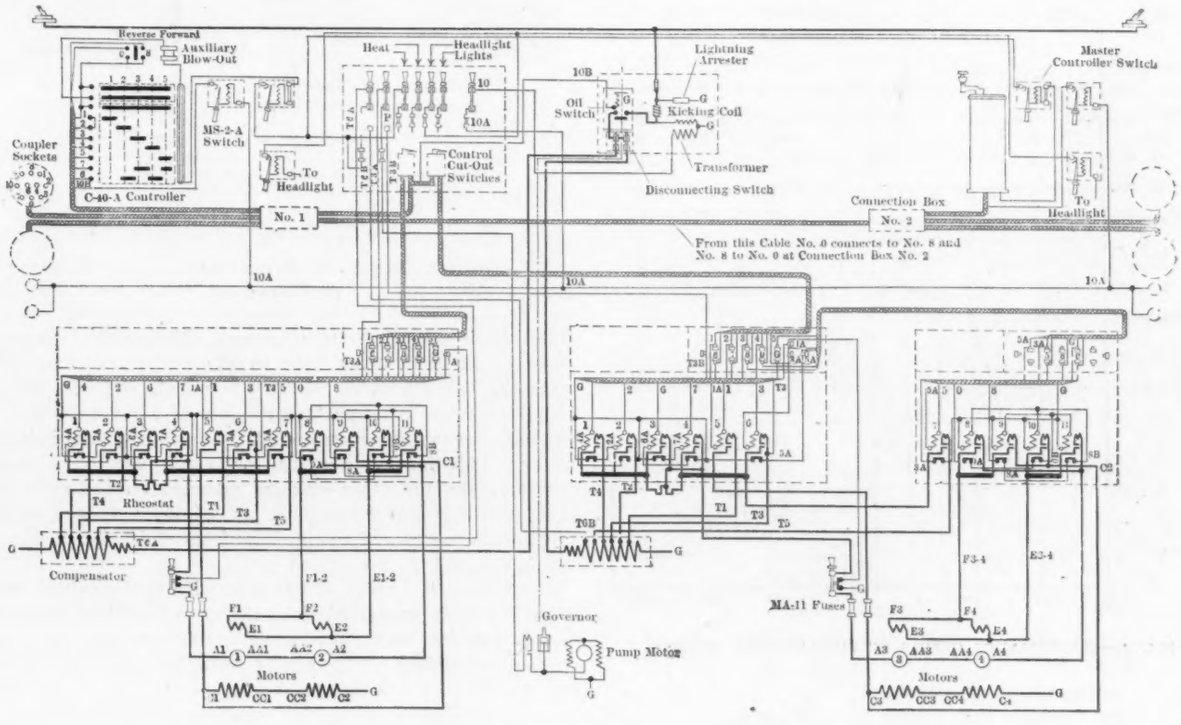


FIG. 1.—MOTOR AND CONTROLLER CIRCUIT FOR SINGLE-PHASE CAR EQUIPMENT.

as a two-motor equipment by simply throwing one blade of the double-knife disconnecting switch. A diagram giving the wiring connections for this is shown in Fig. 1. A dotted line has been drawn through this diagram to show that as far as the motor control is concerned there is a complete and independent two-motor equipment on either side of this central line; the above remarks do not apply to the auxiliaries, such as heating and lighting, etc. Double-throw switches are provided for transferring the auxiliary circuits from one compensator to the other.

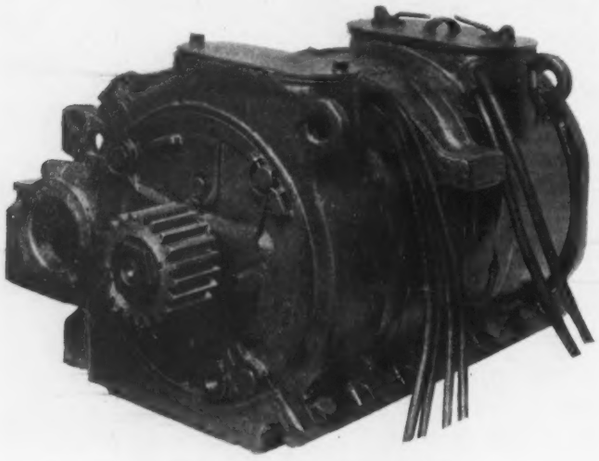


FIG. 3.—EXTERNAL VIEW OF SINGLE-PHASE MOTOR.

It is stated that excellent commutation has been obtained with the motors. Under actual running conditions after the commutators have been in use for some months it is found that they are polished to a chocolate color, and show no signs of pitting from sparking, and service operation indicates a brush life of from 15,000 to 20,000 miles.

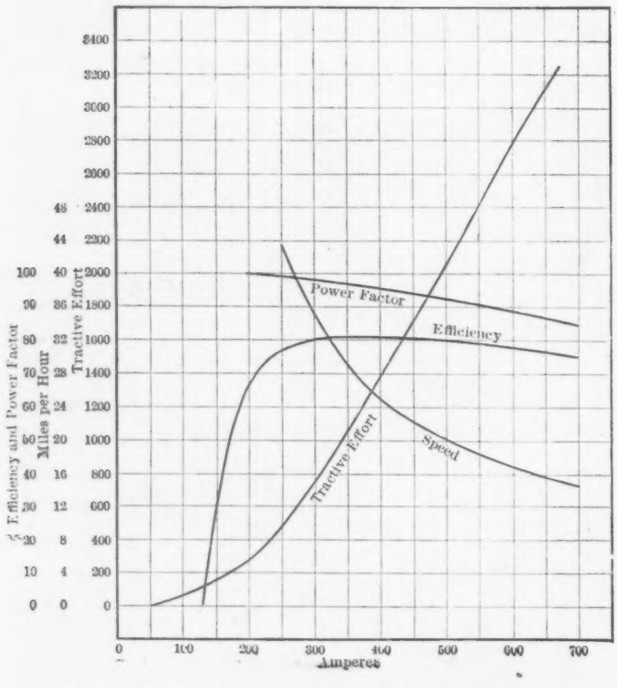


FIG. 4.—PERFORMANCE CURVES OF SINGLE-PHASE MOTORS.

The operation of these motors is well illustrated by a run that was made for the purpose of taking a large party of people from Richmond to Lake Side. On this occasion there were not sufficient electric cars available, so one car equipped with four of these motors was coupled up as a locomotive to a train of five Norfolk & Western standard railway passenger coaches, carrying 300 passengers, and the four motors hauled this load with perfect ease. To test their ability still further, two motors were cut out and the remaining two motors started this same train on a 1 per cent grade. This performance speaks more than could a column of figures for the capability of this new type of motor.

The characteristic curve given in Fig. 2 will show the efficiency, speed and tractive effort at various values of current, while Fig. 3 is an external view of the motor.

Each car is furnished with two pantograph trolleys constructed with steel pans, which material has been found to give much greater satisfaction than either copper or aluminum. The pans are grooved for the reception of a lubricant. The life of these pans will be a matter of considerable interest, but actual figures cannot be obtained until the road has been in operation longer.

Several unique features have been introduced into a substation located at Ashland which supplies energy for lighting the town from the high-tension single-phase trolley. The wiring diagram of Fig. 4 shows how the result was accomplished. It will be seen that the 6600-volt trolley is tapped to feed the high-tension buses from which leads are taken to the high-tension side of the transformers. These transformers reduce the potential from 6600 to 440 volts; leads are taken from the low-tension transformer terminals and pass through a phase-splitting device, which consists of a reactance and resistance, before being connected to a single-phase induction motor. This induction motor forms one unit of a motor-generator set, the other machine mounted on the same base being a single-phase generator. The single-phase generator supplies energy to a 2300-volt bus, from which the feeders to the lighting system are tapped.

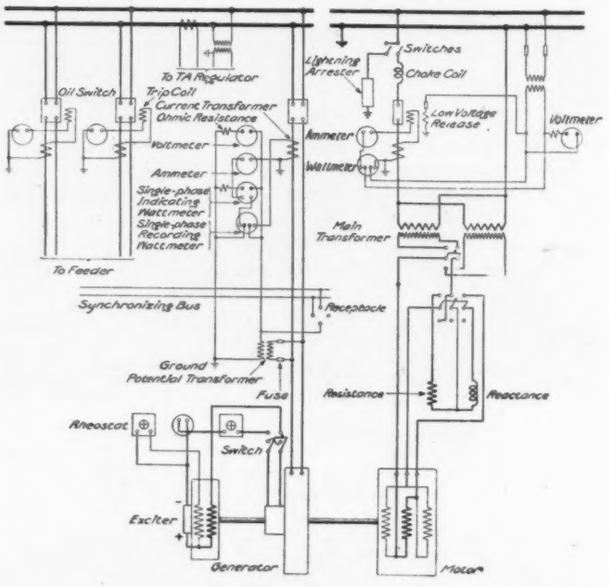


FIG. 5.—CONTROL CIRCUITS OF SINGLE-PHASE MOTOR-GENERATOR SET IN SUBSTATION.

The important feature of this substation is the voltage regulation. This is accomplished by the use of a Tirrill regulator in the Twelfth Street generating station and another at the Ashland substation. The results have been satisfactory and this speaks well for the capabilities of the Tirrill regulator. In all probability it is the first time that an attempt has been made to feed a lighting system from a high-tension single-phase trolley subjected to severe fluctuations of load.

Mr. L. B. Stillwell acted as consulting engineer for the railway company. The electrical equipment of the generating station, cars and substation was supplied by the General Electric Company.

Comparative Tests of Different Types of Electric Fans.

BY ARTHUR C. SCOTT.

IN view of the fact that the literature concerning the various types of electric fans upon the market at present contains very little definite information concerning points other than the power required to operate them, it appeared desirable to the writer to make comparative tests which would show other characteristics of such fans under operating conditions.

Six manufacturers of well-known types of fan motors were accordingly requested to send desk fans to the electrical laboratory of the University of Texas for comparative tests. Each of the companies generously responded to the request by donating a 12-in. fan. Two fans were obtained from one of the companies, one being for direct current and the other for alternating current, so that the data recorded below relate to seven different fans; three of these were built to operate with direct current and four with alternating current.

TABLE I.—TYPES OF FANS TESTED.

Fan	Type	E. M. F.	Speeds
A	D. C. series	110	3
B	D. C. series	115	3
C	D. C. series	115	3
D	A. C. split-phase	104	2
E	A. C. shaded-pole	110–115	5
F	A. C. series	110–120	3
G	A. C. split-phase	100–110	2

TABLE II.—TESTS OF FANS UNDER NORMAL CONDITION.

Fan	Speed	Current	Watts input	Net watts	Power factor	Volume of air del. cu. ft. per min.	Cu. ft. of air per min. per watt	Cu. ft. of air per min. per net watt	Temp. rise of frame	Starting current amperes.
A	1900	.405	44.8	23.11	.....	1215	27.2	52.6	2.6°	.780
B	1520	.431	47.7	16.1	.....	1053	22.1	65.5	8.6°	.595
C	1685	.430	47.7	21.0	.....	1155	24.2	55.0	5.4°	.750
D	1660	.60	36.	11.4	.545	878	24.4	77.0	11.4° C	3.50
E	1460	.97	67.	10.4	.628	837	12.5	80.5	5.4°	1.34
F	1290	.74	58.	23.7	.720	537	9.3	22.7	20.2°	1.00
G	1555	.62	41.5	15.73	.601	997	24.0	62.4	8.0°	1.15

Table I gives an outline description of the seven fans, which for convenience are designated by letters.

The fans were supplied by the manufacturers with the understanding that the tests would be made at 110 volts, and that a frequency of 60 cycles per second would be used with the alternating-current motors. The results of tests under the specified conditions, with the motor circuits adjusted for maximum speed, are shown in Table II.

VOLUME OF AIR.

The determination of the volume of air delivered by a fan motor was found to be much more difficult than at first supposed. Moreover, no reliable formulas have been developed for calculating the power required for moving certain amounts of air. Several attempts to determine the volume of air experimentally by various arrangements proved unsatisfactory. An arrangement which gave excellent results is indicated in Fig. 1. Across a cylinder 8¾ in. in length and 14¼ in. in internal diameter there were placed two strings precisely at right angles to each other. By means of knots on the strings the cross-section of the cylinder was divided into three imaginary concentric areas covering .041, .354 and .712 sq. ft., respectively. The diameter of the imaginary center circle and also the distance from the inner circle to the next circle and from this circle to the inner edge of the cylinder were about the same as the diameter of the anemometer used for measuring the velocity of the air.

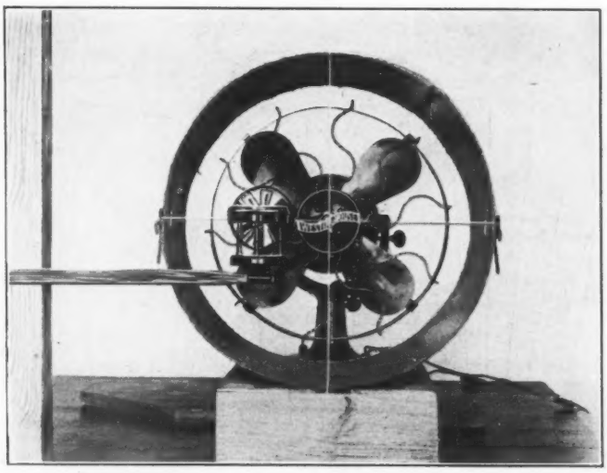


FIG. 1.—ARRANGEMENT OF APPARATUS FOR DETERMINING VOLUME OF AIR.

The fan was placed at the back of the cylinder, as shown in Fig. 1, so that its center should be precisely opposite the intersection of the two strings. Great care was also observed to have the plane of the fan blades perfectly parallel with the plane of the intersecting strings, and to have the fan so placed with respect to the cylinder that no reverse currents of air existed, all of the air which was taken in by the fan being delivered at the front of the cylinder.

With this arrangement it was found that the power input to the fan was perfectly normal, but that a great variation in velocity occurred over the delivery area.

In order to obtain as close an average as possible of the velocities for use in calculating the volume of air blown, four points were selected in each of the two outer rings for placing the anemometer, these points being so marked that the instrument should be placed precisely in the same position for repeated records.

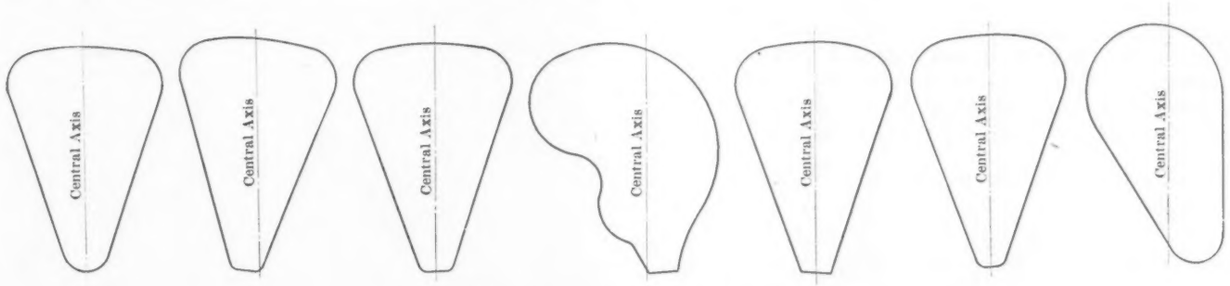


FIG. 2.—BLADES FOR FANS A, B, C, D, E AND F.

In Table II the value for the volume of air in each case represents the corrected average of the averages of five readings for each point in each ring and five readings at the center. It was found that in each case the velocity was greater in the medium size circle than in the outer circle or at the center. In order to arrive at a close value for the total volume blown, therefore, it was necessary to determine the area of each circle separately, as noted above, and multiply by the average velocity

obtained for that circle, and subsequently add the volumes so determined to obtain the final volume.

The volume thus determined for the several fans should be practically correct for each, as all necessary precautions were taken to have similar conditions for the different fans of which determinations were made, and of the several methods tried this one alone appeared to be satisfactory.

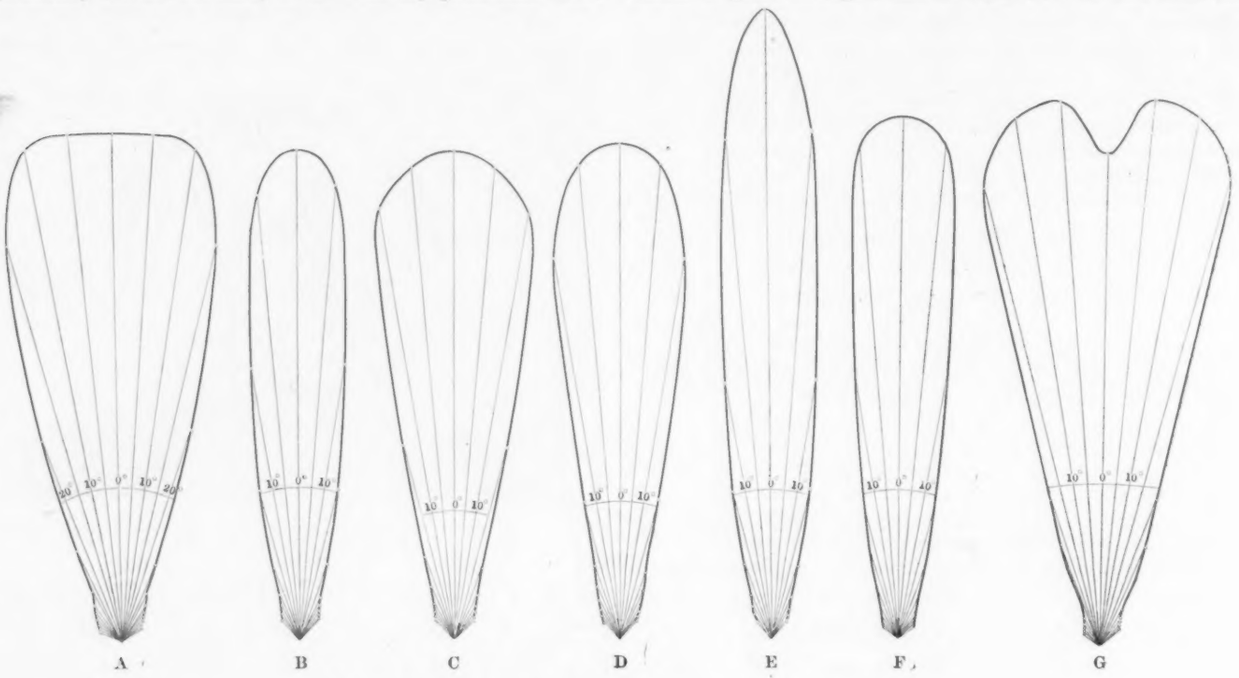


FIG. 3.—DISTRIBUTION OF AIR FROM FANS A, B, C, D, E, F AND G.

THE COMPARATIVE EFFICIENCY OF THE DIFFERENT SHAPES OF FAN BLADES.

In order to arrive at a conclusion concerning the effect which the shape of the blades produced upon the volume of air delivered, the blade-wheel of each of the several fans was fitted accurately to the shaft of one of the motors (A), which was operated at 1600 r. p. m., which speed was only a little above the average of the normal speeds of all of the motors. The results are given in Table III, the same apparatus as shown in Fig. 1 being used for measuring the velocities. For all of the readings taken on the anemometer in use with the cylinder the instrument had a small support, which was maintained in a certain position at the side, as indicated, so that no reflex currents of air could be produced to affect the register of the anemometer, because of the original current striking the observer or any object in front of the fan.

TABLE III.—TEST OF FAN BLADES AT 1600 R.P.M.

Fan	Watts input	Net watts	Cu. ft. of air displaced per min.	Cu. ft. of air per net watt min.
A	30.0	14.14	1025	72.4
B	41.7	20.44	1119	54.7
C	39.4	18.94	1101	58.2
D	22.2	10.00	853	85.3
E	25.2	11.45	903	78.9
F	27.9	13.34	697	52.2
G	30.6	14.74	1024	69.5

TABLE IV.—MECHANICAL DATA OF FAN BLADES.

Fan	A	B	C	D	E	F	G
Length of each blade, in.	5.19	5.40	5.35	5.6	5.38	5.40	5.70
Total diameter of fan, in.	11.53	12.00	12.	12.4	12.	11.87	12.25
Total area of four blades, sq. in.	50.18	51.36	51.12	59.78	51.16	50.70	50.56
Radius of curvature, in.	15.25	6.98	6.6	12.5	19.8	8.1	7.1
Angle α	17° 50′	17° 10′	16° 0′	13° 50′	14° 30′	14° 30′	15° 50′

Information concerning the shape and size of the various fan blades is given in Fig. 2 and in Table IV. In this table the angle α represents the maximum angular displacement of the edges of the fan blades from a plane parallel to and touching the front edges of the blades. The length of the blade was taken as the maximum distance from one end to the other of one blade, while the diameter of the fan represents twice this distance plus the diameter of the hub to which the blades are fastened.

The central axis line shown represents the line of maximum concavity for the blades. The radius of curvature was calculated from accurate measurements made of the concavity of a blade at its maximum point, and the measurements at the same time of the length of the arc subtending a chord passing through that point.

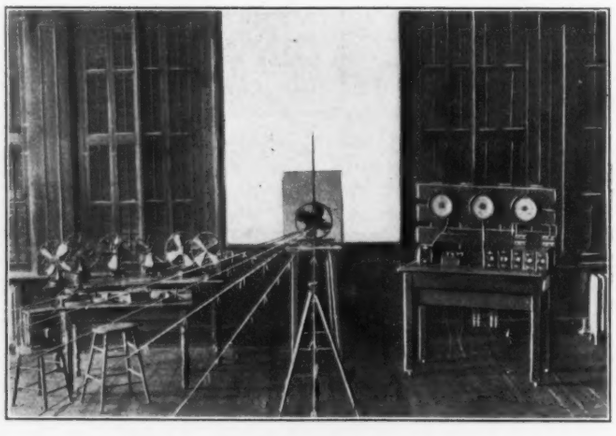


FIG. 4.—ARRANGEMENT OF APPARATUS FOR DETERMINING THE VELOCITY AND DISTRIBUTION.

Reference to Tables III and IV shows that the shape of the blades is of considerable importance in connection with the volume of air delivered per net watt. It appears that the range for the fans tested extends from about 52 to 85 cubic feet of air per net watt.

DISTRIBUTION OF AIR.

Fig. 3 shows the shape of the envelope of the moving air from each fan. Each curve is plotted through points which represent distances from the fan where the velocity was zero

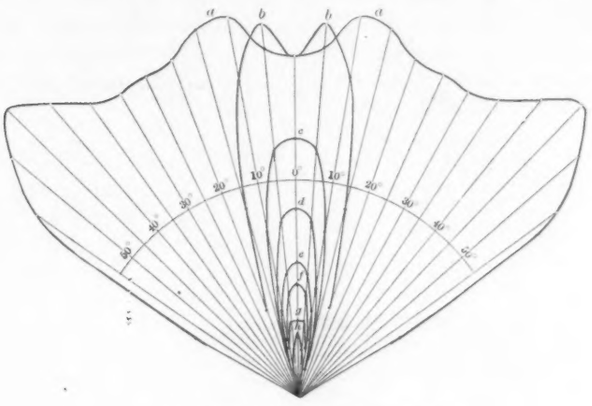


FIG. 5.—VELOCITY OF AIR FROM FAN A.

for five-degree angles, from zero on the center line to 60 degrees, which was the limiting angle where movement of the anemometer occurred for any one fan. The distance at zero angle in the several curves of Fig. 3 are as follows: A, 29 ft.; B, 28 ft.; C, 28 ft.; D, 28.5 ft.; E, 35 ft.; F, 30 ft., and G, 28 ft. These values were obtained with each motor driving its own fan under the electrical conditions indicated in Table II. The arrangement of the apparatus for the determination of distribution of air from each fan is indicated in Fig. 4. The fan and measuring instruments were placed near one end of an empty room about 40 ft. long and 30 ft. wide. In front of the fan guard and close to it a small steel rod was supported rigidly in a vertical position. To this rod were fastened small strings, which radiated outward from the center by five-degree intervals up to 60 degrees in one quadrant. Great care was exercised to be certain that the strings were stretched precisely five degrees apart, and at such a level that the center of the fan blades of the anemometer which was used for indicating the velocity of the air should be precisely in line with the center of the fan. Precautions were also taken to be certain that each and every fan tested should have its top and bottom edges of the fan blades precisely plumb and in line with each other, and also that the plane of the fan blades was absolutely at right angles to the center line extending outward from the center of the fan.

In plotting the curves, it was assumed that the velocity and distribution in the second quadrant were similar to those in the first quadrant, because no difference in data would have been obtained by taking readings in the second quadrant over those obtained for the first. This assumption is considered to be justifiable because every possible precaution was taken in regard to the correct position of the fan with respect to the network of lines, and also to be sure that the anemometer was placed in the same position for each successive reading at any given point.

VELOCITY OF AIR.

By the use of knotted strings the anemometer was placed in various selected positions at chosen distances from the fan and at certain defined angles. Thus the velocity was measured at 6 in. from the fan, and at regular intervals of 2 ft. thereafter up to a distance of 10 ft. 6 in., after which the intervals taken were 4 ft. each. In Figs. 5, 6 and 7, which show the velocities from fans A, D and F, respectively, curve *a* represents the velocity 6 in. from the fan, curve *b* the velocity 2 ft. 6 in., curve *f* shows the velocity 10 ft. 6 in. from the fan, etc. The velocity in ft. per min. at the center 6 in. from the fan (curve *a*) for fan A is 1195, for fan D it is 930, for fan F it is 879.

In taking readings of the velocity the anemometer was always so placed that its center should be precisely over the center of the knot on the string, and a plane, passed vertically through the instrument, parallel to the string, would pass through the center of the string. Moreover, the instrument was always at the same level since it was supported upon a tripod, with the feet so fastened together as to be always of the same height, and to keep the table of the tripod upon which the anemometer was placed always level. The string at all points where measurements were taken was immediately above the center of the table of the tripod and immediately beneath the center of the anemometer, as indicated in Fig. 4.

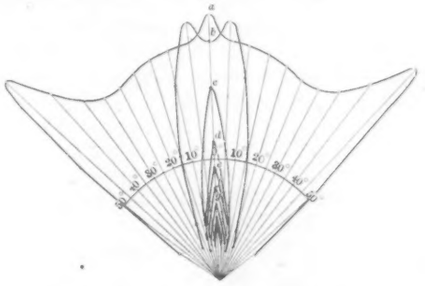


FIG. 6.—VELOCITY OF AIR FROM FAN D.

The velocity curves shown in Figs. 5, 6 and 7 for the different fans indicate the rapid decrease in velocity as the distance from the fan increases, and also the decrease in magnitude of the angle in which the air is blown; and, further, a quite remarkable variation in the form of the surface of revolution produced at 6 in. away from the fan blades, the cross-section of which is shown by the curves.

VARIATION OF VOLUME OF AIR WITH SPEED.

By referring to Tables II and III it is possible to consider the relation of the volume of air blown by any certain fan, because the results recorded in Table II were obtained when each fan was operated at its normal speed, while Table III shows the results as to the volume delivered when the blades of each of the fans were run at a definite speed of 1600 r. p. m. The result seems to show that the volume of air delivered per minute by any particular fan varies directly with the speed.

It will be observed from Table II that the starting current for fan D is much larger than that for any other; its running current, however, is lower than that of any other alternating-current fan. The temperature rise was highest on the F fan; it should also be stated that this fan was more noisy in its operation than any of the others. It will be noted that cubic feet of air delivered per minute per net watt by the E fan was greater than that of any other fan, although the value for the cubic feet per gross watt is nearly the lowest in the list. This result is explainable by the fact that the stray power losses are greater in that fan than in either of the others. The value for the cubic feet per gross watt for the D and G fans is almost double that for the E fan. The D and E fans are provided with field windings distributed in slots—which construction gives minimum magnetic leakage—and a special contact device

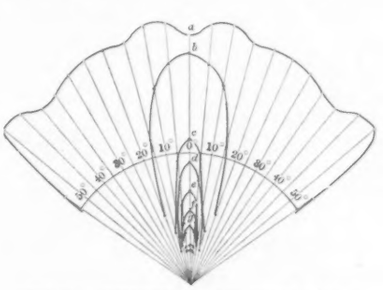


FIG. 7.—VELOCITY OF AIR FROM FAN F.

is connected with the rotor in such a way as to cut the auxiliary starting coils out of circuit when the rotor has reached a certain speed.

The writer is indebted to Mr. B. E. Kenyon and Mr. J. A. Correll for assistance in conducting the tests described above.

Direct-Current Motors, Their Action and Control—V.

By F. B. Crocker and M. Arendt.

In the previous article it was shown that changes in speed are likely to occur with load changes. It can readily be shown that at every load change there will be an excessive change in speed. Study the lines in Fig. 1, from which can be read the speed at one-quarter, one-half, three-quarters or any other fraction of rated torque with any position of the controller arm. For instance, the motor is operating at rated torque and with 3 ohms of resistance in circuit

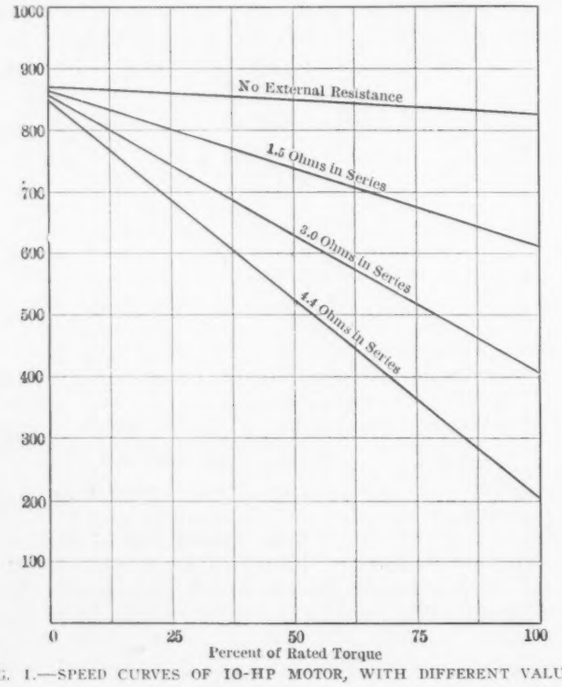


Fig. 1.—Speed curves of 10-hp motor, with different values of box resistance.

(*i. e.*, speed 412) when the load is suddenly reduced to one-half rated torque; from Fig. 1 we see that the speed changes to 635 r. p. m. Using some other methods of speed regulation, to be considered later, the speed variations with changes in load are only very small, from 2 to 4 per cent at a maximum, whereas, by the armature rheostatic method, changes in speed occurring with considerable load variations are so great as to endanger the tool and the work.

That the error introduced by assuming the stray power losses as constant at all speed is small is shown in the following:

Consider, for example, the one-quarter speed condition for which the error due to neglect of the change of stray power losses due to speed change would be a maximum. With speed at one-quarter rated value, and at the rated torque, the motor output would be equal to 1887.0 watts. The various resistance losses would be the same as at rated load, or 675.0 watts. The total stray power loss is made up of eddy current, hysteresis, friction and windage losses, the first of which varies as the square of the speed, while the others vary directly as the speed. In motors of about 10 horse-power capacity the various losses are approximately in the following proportion:

Eddy current loss, one-quarter of total stray power loss.
Hysteresis loss, one-quarter of total stray power loss.
Friction and windage, one-half of total stray power loss.

The eddy current loss at normal speed is $\frac{526}{4}$, and at one-quarter speed is $\frac{526}{4\times 4^2}=8.2$. The hysteresis loss at normal speed is $\frac{526}{4}$, and at one-quarter speed is $\frac{526}{4\times 4}=32.8$. The friction and windage loss at normal speed is $\frac{526}{2}$ and at one-quarter speed is $\frac{526}{2\times 4}=65.6$.

Adding these values, the corrected stray power losses for one-quarter speed are 107 watts. The total motor losses at this speed are, therefore, $675+107=782$ watts. The motor input is 8740 watts; motor loss, 782 watts, and motor output is 1887 watts; hence, the loss in the rheostat is $8740-(1887=+782)=6070$ watts; thus $R_x=\frac{6070}{37^2}=4.45$ ohms, or only .05 more than that obtained by calculation with stray power losses assumed constant. Accordingly the error introduced by this assumption may be assumed as negligible.

2. *Speed Control by Brush Shifting.*

Speed variation by means of brush shifting is not desirable, as it increases armature reaction and tends to produce sparking. The proper position for the brushes is practically fixed by the design of the machine and any other setting is not conducive to good operation. Curves are given in Fig. 2 showing how the speed can be controlled by brush shifting within the sparking limits, this range being small. It is interesting to note in connection with Fig. 2 that armature reaction in a motor due to a considerable negative lead of the brushes can be made to maintain a constant or rising speed. This is not a feasible method, however, because in the operation of direct-current motors it is practically necessary to set the brushes in the position of *minimum sparking*, since sparking is the most troublesome feature of these machines.

3. *Speed Control by Variation of Field Flux—Rheostatic Method.*

The equation $e=\frac{\phi nN2p}{60\times 10^8\times b}$ shows that if e is kept constant, and ϕ varied, the speed n varies inversely as the flux ϕ. This relation, therefore, indicates a method of speed variation.

In the case of ordinary shunt motors, the range of speed variation by means of field weakening is small. For instance, take the 10-hp motor previously considered and weaken its field to produce 30 per cent increase in speed. Since the flux must be varied inversely as the speed, it must be weakened in the proportion 130:100 or 100:76.9, that is 23.1 per cent, while to produce this change the field ampere-turns must be reduced by about 50 per cent. At rated torque with this reduced field strength the armature current must be increased 30 per cent, and the ratio between back ampere-turns and field armature-turns instead of having its normal value of .10 is raised to $\frac{.13}{.5}=.26$, because as the former is 30 per cent greater and the latter is reduced to one half. This ratio is excessive. Similarly the corresponding increase in cross ampere-turns acting collectively with the increased back ampere-turns causes excessive sparking, showing that a 30 per cent increase of speed

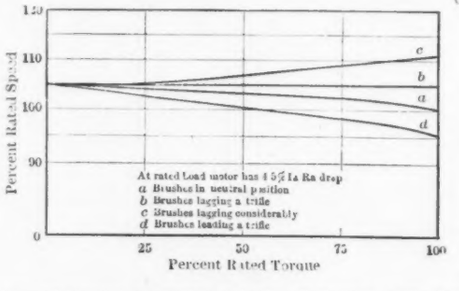


Fig. 2.—Relation between brush position and speed.

with an ordinary standard shunt motor cannot be obtained without very objectionable or even prohibitive sparking.

It can also be shown that the increased armature current to maintain constant torque augments the I^2aR_a loss, which in the 10-hp motor armature rises from $37^2\times .28$ to $48^2\times .28$, or an increase of 234 watts, producing too much heat for the armature insulation to stand for any length of time.

All adjustable speed motors of the flux variation type are ***not constant torque machines, but constant horse-power or output motors; i. e.,*** the torque falls as the speed increases in inverse ratio, or $T\times$ r. p. m. = a constant. In fact, unless the

ratio of back ampere-turns to field ampere-turns is less than 10 per cent at minimum speed, an increase in speed of even 30 per cent with constant output is not possible, as shown above.

It is evident that a shunt motor to have any considerable range of speed variation (*i. e.*, increase of more than 20 or 30 per cent) by field weakening requires special design, because the normal field must be more powerful with respect to the armature than in the case of standard single-speed motors. Some special motors of this kind allow of speed variations of four to one, with constant horse-power output, but not at rated torque. These increased speed ranges are obtained as follows:

(*a*) *Magnetic Circuit of Very Soft Steel.* The magnetic properties in this case are such that even with high flux densities the bend of the curve is not reached, so that the change in field ampere-turns to produce a large change in flux is not excessive; *i. e.*, the rate of change of flux and m. m. f. are almost in direct proportion. With these machines the field frame is also large, the total flux being very great, while the armature winding consists of fewer turns per section and a larger number of sections, so that the self-induction per section is low. Thus, under normal or even exceptional conditions the ratio of field to back ampere-turns is kept within 10 per cent. However, a machine having a field of sufficient strength to prevent sparking at high speeds must have a frame considerably larger than necessary for a single-speed machine of equal power and the commutator must have a greater number of bars. In general, when considering this type of variable-speed motors, it can be stated that the percentage of speed increase of which a normally loaded motor is capable by means of field weakening (rheostatic control) is a measure of its overload capacity with full field strength. In other words, *a given range of speed variation demands a motor having a certain increased capacity.* The following practical examples illustrate this point:

Relative Sizes of Frames, 1 to 2-Speed Ratio:
3-hp. frame for a 2-hp motor.
15-hp frame for a 10-hp motor.
Relative Sizes of Frames, 1 to 3-Speed Ratio:
3-hp frame for a 1½-hp motor.
10-hp frame for a 5-hp motor.
20-hp frame for a 10-hp motor.

(b) *When the magnetic circuit* has been designed so that the *flux density is always great at the pole tips,* the field distortion due to armature reaction is lessened and a normal flux is maintained in the commutation zone, giving sparkless operation within reasonable speed and load limits.

(c) *A commutation field* may be maintained by a compensating winding, which prevents field distortion (Thomson-Ryan method, etc.), or by auxiliary poles placed directly over the zone of commutation, the strength of the auxiliary poles increasing in direct proportion to armature load though armature reaction is not eliminated. The object of this auxiliary field is to provide a flux for reversal, which increases in proportion to the motor load and reverses when motor rotation is reversed; thus sparkless operation with weak fields may be obtained.

Electrical Exhibit in a Providence Department Store.

In the largest and most prominent department store of Providence, R. I., that of The Shepard Company, on Westminster Street, an electrical exhibit was given in connection with an annual food fair. The fair lasted four weeks and has just been brought to a successful termination. The electrical display was made by the Narragansett Electric Lighting Company and its merit was best attested by the crowds which surrounded the two sections of the booth.

Each section of the booth was open at the ends nearest each other with a passageway of six feet between. On each corner of each section were wooden columns with clusters of six 4-cp lamps on each. Between the sections, an arbor of apple blossoms was draped, completely hiding the wiring of the decorative outfits which were intertwined throughout. The effect of this arbor was very pleasing.

No attempt was made to give any extensive cooking demonstrations; but one of the two salesmen who were in attendance demonstrated the coffee percolator, bread toaster and corn popper. Electric heating and other special devices have undoubtedly been shown in all of the food fairs held recently, so it will be of little interest to describe the usual run of flat-irons, curling-iron heaters, chafing dishes, etc., that are usually shown at these exhibitions. Three of such fairs have been held in Providence, so that it was necessary to exhibit new devices to gain the interest of the public. With this end in view new devices only were featured, even though some were of very little, if any, revenue-making value. By this means a great many people were attracted, giving the demonstrators an opportunity to offer the more popular devices.

Among the devices new to the consumers was an open fireplace cleverly arranged with broken colored glass on top and two lamps and a heating unit hidden underneath. A huge electric stove with a tea-kettle holding seven and one-half gallons was mounted in the center of one of the booths and was kept constantly heated. In front of this was displayed another stove with a tea-kettle holding one pint. An electric hair-dryer was prominently displayed and an electric radiator and foot-warmer were within easy reach of visitors who could feel the heat given off by both.

The industrial utensils were represented by electric glue pots,

ELECTRICAL EXHIBIT IN A PROVIDENCE DEPARTMENT STORE.

one of which was partly filled with glue and often operated; soldering coppers, sealing wax pots and melters, lead pots containing molten metal, hat conformers, tailor's goose and puff-irons, cork branders, immersion coils, wood bender, sterilizers, water heaters and urns.

The new devices in the domestic section were a shaving mug, bread toaster and corn popper as exponents of electric heating; a washing machine and ice-cream freezer, both in operation, as exponents of motor-driven devices for domestic use. A competent operator was furnished by the store management at its expense to demonstrate the sewing-machine motor in exchange for the possibilities of making sales for the department store's make of sewing machines. Different makes of vibrators, small motors, etc., including a bottle-washer, were shown. A feature of the exhibit was a large "light"-frosted wedding cake, 28 in. high, lighted by miniature red and frosted lamps.

While the department store management advertised the exhibit, it had nothing to do with it, the Narragansett Electric Lighting Company having rented the space. The company sent out invitations to its customers and prospective customers, and the energy consumed by the devices was taken from its mains. The commercial department of the company is under the direction of Mr. E. R. Davenport and it is interesting to note that there has been no curtailment of any character made in the new business department owing to business depression. As near as can be estimated from actual conditions of operation, the income from energy consumed by heating devices last year amounted to about $15,000.

Testing Electric Meters at Their Place of Installation—I.

By Joseph B. Baker.

METER INSPECTOR'S EQUIPMENT.

For testing, repairing and calibrating service meters on the consumers' premises, the following apparatus, tools and materials may be carried:

APPARATUS.

Voltmeter and ammeter, or wattmeter.
Slide rule.
Stop watch.
Artificial load.
Storage battery, or low-potential transformer.
Test lamp, with special lead, for testing armatures.
Portable torque balance.

TOOLS.

Small soldering iron.
Small gasoline torch or alcohol lamp.
Screwdrivers, large and small.
Pliers, long-nose and side-cutting.
Tweezers.
Fine files.
Monkey wrench.
Special wrenches, including a spring wrench for handling pivots.
Electric pocket lamp.
Needles, for testing jewels.
Small level (pocket size, of brass), or small brass weight.
Old meter shaft, for holding pivots for examination.
Pieces of soft wood to use as cleaning implements.
Meter repair kit.
Sealing tool (Fig. 1), with a supply of lead seals.
Magnifying glass (preferably a watchmaker's glass).
Camel's hair and bristle brushes, including one "tooth brush."
Small hard rubber air syringe.

SUPPLIES.

Resistance cards.
Dial hands.
Commutator brushes.
Prepared wire solder, with rosin flux.
Fuse plugs, wire and links, assorted sizes.
Cotton waste.
Crocus sticks and cloth.
Heavy insulated wire, for test connections.
Connectors.
Webbing for cleaning commutators (corset strings, shoe strings, or ¼-inch cotton tape free from lint).
Watch oil.
Benzine.
Jewels and pivots.
Wing-nuts.
Assortment of the screws and washers used in various types of meters.
Black and white "friction" tape.
Insulations for resistance card and other internal meter connections.
Meter-cover window glasses and putty.
Special flexible cord for instrument connections.

MISCELLANEOUS.

Adjustable shunt field coils, to equip old-style commutator meters.
Meter magnets of standard strength.
"Creep retarders"—ordinary wire paper clips answer well.

It may not be necessary to include all of the articles given in the above list; the outfit may be simplified to suit individual requirements. On the other hand, there have doubtless been omitted some special articles, in each section of the list, that have been adopted by individual meter men for general testing or in connection with the testing of certain meters. A number of the tools listed individually are included in the pocket kit of meter adjustment tools, a list of which is given below.

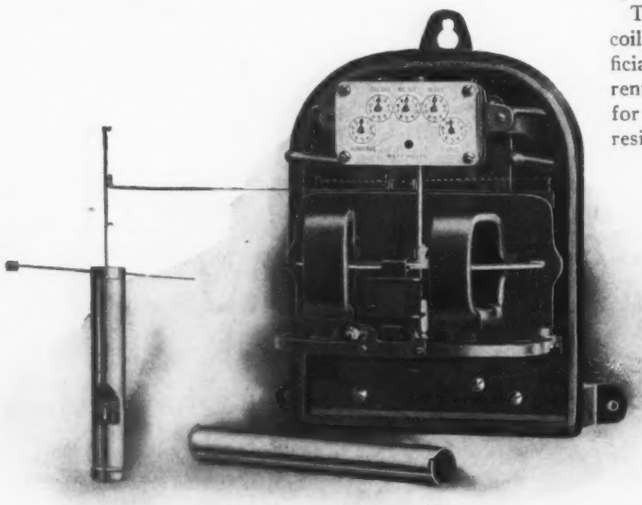


FIG. 2.—PORTABLE TORQUE BALANCE IN USE WITH WATT-HOUR METER.

Apart from the ordinary electrician's tools, such as pliers and screwdrivers, the apparatus, tools and materials given in the list are furnished by the central station company, and should be kept in first-class shape. The entire kit may be charged out to the tester or inspector for the particular work in hand instead of being left permanently in his possession. Under these conditions there is no excuse for poor or unfit tools in the testing outfit, and a good moral effect is exerted on the company's customers, who will, naturally, place more confidence in the test when they observe that the inspectors' outfits are in first-class condition.

Following is a detailed discussion of a number of the items:

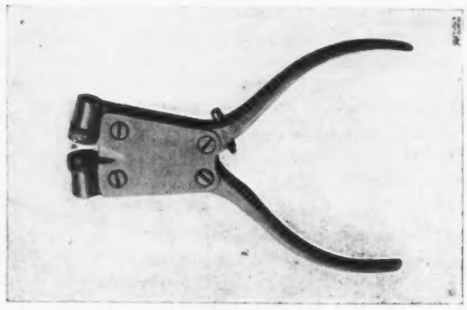


FIG. 1.—SEALING TOOL.

In some instances, an indicating wattmeter may be carried instead of the voltmeter and ammeter, and is to be preferred for testing alternating-current meters. This type of instrument is not reliable for testing direct-current meters on consumers' premises, however, owing to the influence of stray magnetic fields, which cause inaccurate indications. Many companies are now using milli-voltmeters with separate shunts, instead of self-contained ammeters, ironclad, to afford protection from stray fields, with 1.5, 15 and 150 ampere scales; voltmeters, also ironclad, with 150 and 300 volt scales; and similar instruments of larger rating for testing larger sizes of consumers' meters.

In carrying instruments from place to place, care should be taken to avoid rough handling and jarring of the instruments. In riding in street cars, for example, the instruments should not be placed on the floor, where they would be subjected to jarring, and also to possible disturbance to their calibration by stray magnetic fields from the car motors.

The stop watch carried for testing meters should be of good quality; the ordinary cheap stop-watch is not adapted to stand up under the work.

The artificial load may consist of a lamp bank, a resistance-coil rheostat, or a water rheostat. The two first-mentioned artificial loads are most commonly used in testing both direct-current and alternating-current meters, and may be uncalibrated for use with the ammeter, or in calibrated form as "standard resistances." For the testing of meters of small and medium

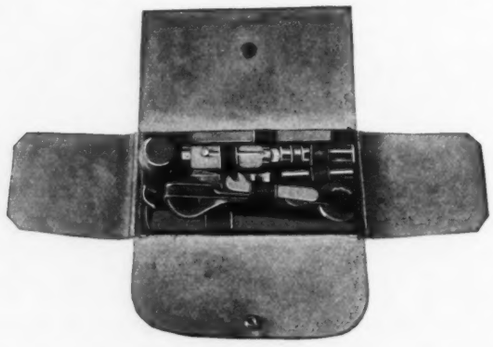


FIG. 3.—METER REPAIR KIT IN POCKET CASE.

rating, a simple and compact form of lamp bank, which may easily be carried in the tool bag, may be made by wiring four incandescent lamp key sockets together. By using lamps of various candle-powers, carried separately in the tool bag, a load varying from one 4-cp lamp up to four 50-cp lamps may be put on the meter. Another convenient form of lamp

bank consists of a group of 20 16-cp or 32-cp lamps, mounted in an open wooden frame with the lamps inside so as to protect them from being broken in carrying. The lamps may be placed in key sockets, to facilitate adjusting the load through a fairly wide range, and may be wired up on a three-wire plan.

The storage battery may be a single cell of the Edison nickel-steel type. A compact cell of this type, weighing less than 15 lb. and capable of delivering nearly 150 amperes, is very handy for testing direct-current meters on artificial load without disturbing the consumer's supply.

The low-potential transformer may be used to advantage in testing alternating-current meters on artificial load without disturbing the consumer's supply.

Fig. 2 shows a portable torque balance made by the General Electric Company for measuring the torque of any motor meter. The device consists of a light moving system suspended in highly polished bearings, and connected by a lever to the meter shaft so that the torque of the latter is balanced against a standard weight. The weight may be 1 gram or ¼ gram, and any one of three lengths of balance arm and shaft lever may be employed. The condition of balance is noted on an index contained within the 7¼ in. x ¾ in. tubular case of the device; the final balance being obtained by varying the load on the meter. The torque, in millimeter-grams, is found by a simple formula involving the balance weight and the length of the lever.

A "jeweler's iron" is large enough for all soldering that may be necessary in connection with the inspection of a meter on the customer's premises.

An "ever-ready" lamp answers well for many purposes. For examining small parts of the meter, however—such as register wheels or worm, or jewels and pivots—a diffused light is better than a concentrated one, since the contrasting effect of the latter is very misleading.

A small level is often used for leveling the meter in installing, and for ascertaining whether the meter is level preliminary to a test for calibration. A better way to level the meter, however, is to load the disk (or "cup") with a small brass weight, such as is furnished by some meter manufacturers for the purpose; a ½-in. length of ¾-in. brass rod answers well, or a silver half dollar will do if there is room to use it. Place the weight on the front or back edge of the meter disk—whichever is more convenient—and note whether it causes the disk to rotate one way or the other. If it turns the disk to either side, raise that side of the meter enough to level it from left to right. Then place the weight on the edge of the disk at the right or left, i. e., at a point 90 deg. away from the former position, noting whether it turns the disk either way, and leveling accordingly, from front to back, without changing the right-to-left leveling. This method is much more accurate than by the use of a small level, and is very sensitive, so that it may be necessary to relevel from right to left, and then from front to back, to obtain a perfect leveling of the meter.

As cleaning implements, one or two orange-wood manicure sticks, sharpened to a point at one end and to a chisel edge at the other, and a few large-size, good-quality toothpicks, answer well.

A neat pocket kit, sold by the General Electric Company (Fig. 3), consists of articles contained in a small leather case, as follows: Folding screwdriver, with ⅛ in., 3/16 in., ¼ in. and 5/16 in. tips; double-end wrench, ¾ in. and 11/16 in., for new and old-style jewels; double-end wrench, ⅜ in. and 3/16 in., for top bearing nut and brush nut; pivot wrench; combined needle for testing jewels, and brush twister for setting and straightening brushes; spirit level; magnet cleaner, for removing dirt between disk and poles of magnets; brush cleaner; piece of ¼-in. cotton tape, for cleaning commutator; piece of ¼-in. crocus cloth, for cleaning commutator, and bottle of porpoise oil.

The air syringe should always be used instead of blowing with the breath, which is liable to precipitate moisture and thereby cause rusting or tarnishing.

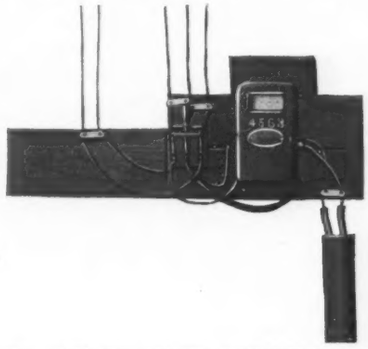
In all soldering about a meter, rosin only should be used as a soldering flux, since the use of any other flux may cause the liberation of acid fumes which would attack the commutator or other parts of the meter.

Insulations consisting of ordinary soft rubber tubing of small bore, cut off in lengths and slipped over resistance card leads or other wires in a meter, while often used, are not to be recommended, as the sulphur in the rubber is liable to attack the meter contacts, more especially the commutator and brushes of a commutator meter, tarnishing them and introducing high resistance. Tubing made of so-called "medicinal rubber" is said to be free from these objections, however, and is used by some meter manufacturers.

For making test connections, ordinary lamp cord is employed by some companies, using several strands taped together and soldered into common terminals at the ends, to give sufficient carrying capacity. Other companies use regular generator brush-holder leads of low resistance with heavy braided, rubber-covered insulation, finding these leads superior to the lamp cord on account of their greater flexibility, more durable insulation and more complete freedom from breaking and "sticking through" of the strands.

A Method of Stopping Energy Stealing.

The accompanying photograph was taken by the meter department of a prominent Southern central station in connection with theft of energy in a job printing-office. It was the practice of the owner of the establishment to hook a homemade lighting circuit across the incoming service switch of a 10-ampere-meter, three-wire power line, on the street side of the meter after the meter-reader had been around, and to take the lines away a few days before the meter-reader's time to come



METHOD USED FOR TAKING UNMETERED ENERGY.

again occurred. It happened that one of the company's inspectors visited the place unexpectedly, and arrangements were at once made to obtain the photograph as evidence, in the presence of the city electrician as a witness. The owner was confronted with the photograph, which was taken in his absence, and the company proposes to stop future depredations of this character by making an example of each offender against whom photographic evidence can be obtained.

Fuses in Outdoor Lightning-Arrester Circuits.

It is the practice of the Union Electric Light & Power Company, of St. Louis, to place in series with its lightning arresters out on the line a No. 19 copper-wire fuse inside of a glass

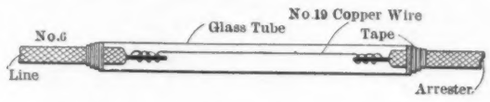


FIG. 1.—FUSE FOR OUTDOOR CIRCUITS.

tube, as shown in Fig. 1. This No. 19 wire is spliced into the No. 6 wire leading to the arrester and over it is slipped a glass tube, held in place with tape wrapped around the wire and the

ends of the tube. The General Electric lightning arrester is used, the iron box being lined with asbestos stuck in with shellac in the company's shops, before the arrester is put up.

Where there is a change from underground to overhead construction, a choke coil is inserted between the cable and the lightning arrester tap, this choke coil being very simply constructed by giving the conductor 12 to 14 turns around itself, as shown in Fig. 2.

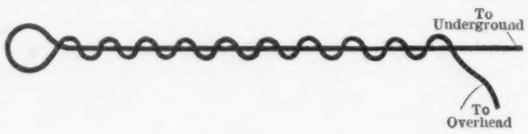


FIG. 2.—CHOKE COIL USED BETWEEN CABLE AND ARRESTER.

Data on Elevator Service from Dayton, Ohio.

By the courtesy of Mr. F. M. Tait, general manager of the Dayton Lighting Company, of Dayton, Ohio, we are enabled to present data on 38 elevators, representing 437 rated horse-power in the city of Dayton. In the issue of Feb. 1 some information was given on the policy of New England companies as regards elevator load. The figures in the accompanying table were taken direct from customers' accounts of the Dayton Lighting Company, and show conditions of load and demand from elevators as they exist in the down-town district of a town of 90,000 inhabitants. From these 38 elevators, representing 437 horse-power, the total revenue for six months was $3,308.42. The average receipts per month per elevator were $14.51. The average horse-power per elevator was 11.5. The receipts per horse-power per month were $1.26. The average net rate per kw-hour was $.042. For the six months the total kw-hour consumption was 78,656. The load factor (that is, the ratio of the average load to the connected elevator horse-power) was 5.5 per cent.

In order to give an idea of the exceedingly variable and intermittent character of the elevator load in a city the size of Dayton, the accompanying table showing the kw-hour consumption and amount received from each elevator by months for a period of six months is given. It will be seen that most of the elevators are of what would be considered small horse-power capacity in a large city. The amount received per elevator in some cases varies considerably from month to month. There is also a decided difference between customers, as would be expected. The income per horse-power is considerably below the readiness-to-serve charges commonly made for ordinary stationary motors in cities where a readiness-to-serve rate is in vogue. However, the diversity factor of an elevator motor load is very low. In other words, the ratio of the maximum aggregate demand at any moment to the rated horse-power of the elevators connected is low. It is not, therefore, usually considered equitable to charge elevator motors as high a readiness-to-serve rate as motors which run continuously for an hour or more at a time. In a large city, the elevator income and load are, of course, a much more important part of the whole than in small cities. In a city like Chicago, as shown by Mr. L. A. Ferguson in a paper which he presented to the A. I. E. E. in 1907, the electrical energy taken by elevators may amount to as much as 12.5 per cent of the total output of the central-station company.

DATA ON ELEVATOR INSTALLATIONS AT DAYTON.

Size of motor H.P.	MAY		JUNE		JULY		AUGUST		SEPTEMBER		OCTOBER		Total am't. for 6 months
	Kw-H.	Am't.	Kw-H.	Am't.	Kw-H.	Am't.	Kw-H.	Am't.	Kw-H.	Am't.	Kw-H.	Am't.	
.5	62	$3.89	59	$3.70	71	$4.45	48	$3.01	75	$4.71	72	$4.52	$24.28
.5	90	5.65	103	6.22	82	5.14	85	5.33	85	5.33	89	5.78	33.45
.5	58	3.63	64	4.01	77	4.83	64	4.01	62	3.89	64	4.01	24.38
.5	60	3.77	81	5.08	74	4.64	61	3.82	70	4.39	94	5.89	27.59
.5	57	3.58	40	2.51	36	2.26	44	2.76	40	2.51	34	2.14	15.76
.5	86	5.39	90	5.65	72	4.52	73	4.57	68	4.26	88	5.71	30.10
.5	44	2.90	45	2.25	31	1.55	53	2.65	51	2.55	58	2.90	14.80
.5	4	2.14	4	2.14	..	.....	46	2.88	36	2.26	12	2.14	11.56
.5	45	2.83	64	4.01	85	5.33	72	4.52	79	4.95	78	4.89	26.53
.7	6	3.00	6	3.00	11	3.00	5	3.00	5	3.00	3	3.00	18.00
.7	54	3.41	36	3.00	35	3.00	34	3.00	40	3.00	64	4.01	19.42
.7	169	10.20	162	9.77	97	6.08	64	4.01	61	3.82	94	5.90	39.78
7.5	35	2.20	37	3.21	40	3.21	34	3.21	40	3.21	46	3.21	18.25
7.5	16	3.21	19	2.14	17	3.21	17	3.21	16	3.21	17	2.14	17.12
7.5	26	2.14	37	3.21	33	2.14	40	3.21	31	3.21	39	3.21	17.12
8.	56	3.51	61	3.82	61	3.82	....	.....	....	.....	....	.....	11.15
8.	143	8.63	136	8.20	93	5.83	105	6.33	90	5.65	105	6.33	40.97
8.	29	3.42	38	3.42	32	3.42	38	3.42	30	3.42	39	3.42	20.52
10.	464	27.11	387	22.61	435	25.42	359	20.97	358	20.91	409	23.90	140.92
10.	171	10.31	184	11.10	148	8.86	161	9.71	235	14.18	274	16.53	70.69
10.	111	6.69	148	8.83	142	8.56	147	8.88	214	12.51	281	16.95	62.42
10.	360	21.04	208	12.54	141	8.51	292	17.06	452	26.41	384	22.43	107.99
10.	44	1.67	584	22.19	1365	51.87	1440	54.72	1583	60.15	1861	70.71	261.31
10.	....	.....	16	1.00	75	4.71	92	5.73	67	4.28	80	5.02	20.74
10.	191	11.52	230	13.87	234	14.11	89	4.58	201	12.03	202	12.18	68.29
10.	1071	40.69	657	24.96	340	12.92	1216	46.20	1650	62.70	1520	57.76	245.23
10.	52	4.28	49	4.28	57	4.28	63	4.28	76	4.76	82	5.14	27.02
10.	229	13.82	231	13.93	234	14.11	200	12.07	261	15.75	318	18.68	88.36
10.	53	4.28	50	4.28	32	4.28	33	4.28	45	4.28	47	4.48	25.68
11.	171	10.31	158	9.53	131	7.90	....	.....	287	16.77	223	13.46	57.97
12.	554	32.37	447	26.12	340	19.87	264	15.93	264	15.93	....	.....	110.22
15.	190	11.46	144	8.69	82	6.42	66	6.42	111	6.69	104	6.27	45.95
15.	355	20.74	407	23.78	423	24.71	336	19.63	336	19.63	471	27.52	136.01
15.	10	.63	315	18.41	306	17.87	289	16.83	286	16.71	343	20.04	90.49
15.	659	38.50	707	41.31	834	44.37	143	8.63	1429	73.31	915	48.68	254.80
15.	53	6.42	57	6.42	40	6.42	41	6.42	46	6.42	52	6.42	38.52
18.	176	10.62	198	11.95	165	9.95	52	7.70	248	14.96	147	8.87	64.05
27.5	4114	113.12	7832	215.38	6047	166.29	6191	170.25	5854	160.98	5635	154.96	980.98

Electric Pumping from Deep Wells.

A paper by Charles B. Burdick presented before the Western Society of Engineers, which, together with the discussion thereon, appears in a recent *Journal* of that society, is of considerable interest to central station companies considering city contracts for pumping from deep wells.

The reciprocating deep-well pump, with the pump cylinders deep in the well, is first briefly discussed. He states that where the quantity of water is small and the lift moderate this machine operates with good results; but where considerable water is handled, especially at high lifts, it has proved both costly of operation and maintenance. With the single-acting plunger the water column must be started and stopped once in each revolution and twice with the double-acting plunger. This operation, especially at high piston speed, is both extravagant of power and hard on machinery. This difficulty has been partially overcome by the use of the differential plunger. He gives tests of three Johnson deep-well pumps which had efficiencies ranging from 72 to 67 per cent, which he thinks probably represents the best that can be hoped for by reciprocating machinery under lifts of from 274 to 252 ft.

The air-lift pump, which consists simply of a jet of compressed air from a small pipe discharged into a pipe of larger diameter sunk below water level, is discussed at length. With an air lift the depth to which the air pipe is submerged and the consequent pressure of the air undoubtedly has an important bearing on efficiency. It is usual to express this submergence as the ratio of the total height of the mixed air and water column to the height of the column which is submerged in the water of the well; the total height of the mixed column being measured from the point of air application to the point of delivery of the air and water mixture. Experiment and experience seem to show that the best results are obtained under a submersion of about 66 per cent, and that with lifts of 50 ft. or less the efficiency is reduced to about one-half when the submersion is reduced to 33 per cent. The most favorable air pressure is one slightly in excess of the pressure caused by the head of water due to submergence, and the air pipes and passages should be so proportioned as to permit the passage of the proper quantity of air without seriously reducing its pressure.

Tests on the efficiency of air-lifts are quoted from various sources, ranging all the way from 53 to 17 per cent, considering only the efficiency of the air-lift and taking no account of the efficiency of the compressor. It seems to be the general impression, and this is borne out by such tests as have been made public, that the efficiency of the air-lift as a pump, not considering the compressor, ranges between 25 and 40 per cent under favorable conditions and for medium lifts. As to compressor efficiencies the author thinks it probable after considering various figures that no injustice will be done by assigning an efficiency of 60 to 75 per cent for such steam-driven compressors as can properly be placed in the ordinary water-works installation. He takes up the vertical-shaft high-speed centrifugal pump sunk deep in the well casing, and refers to the installation at La Grange, Ill., which was described in the ELECTRICAL WORLD, first issue of February, 1907. To accommodate this centrifugal pump the wells were reamed out to a diameter of 16 in. to a depth of 120 ft., and a three-stage Byron-Jackson pump sunk in the opening thus secured.

In the discussion Mr. O. C. Spurling made some interesting comparisons between the La Grange centrifugal pumps and a double-acting steam-driven deep-well pump at the Hawthorne plant of the Western Electric Company. The average results obtained from a continuous run of 168 hours showed that 226 gal. per minute were pumped against a head of 80 ft., with a consumption of 12.5 lb. of steam per minute. The consumption of steam per hydraulic hp-hour was 164.3 lb., and as the steam delivered to the pump costs 35 cents per thousand pounds, the cost per hydraulic hp-hour is 5.75 cents, and for pumping 1000 gal., 1.93 cents. Assuming that the efficiency of the centrifugal motor-driven vertical-shaft pumps at La Grange is 50 per cent and the motor efficiency 85 per cent, a motor would take 1.75 kw-hours per hydraulic hp-hour. [The overall guaranteed motor and pump efficiency was 55 per cent, which was exceeded in tests made since this discussion ttok place.—EDITORS.] Assuming that the pumps were supplied with energy at 2 cents per kw-hour, the cost per hydraulic hp-hour would be 3.5 cents, and the cost of pumping 1000 gal. would be 1.18 cents. He also considered some wells cited by the author using compressed air, where 450 gal. per minute were pumped against 63-ft. head, with 67-lb. air pressure, the air consumption being 2.3 cu. ft. of free air per minute. Assuming a cost of 7 cents per 1000 cu. ft. of free air compressed to 75 lb. pressure (the Western Electric Company's cost for air compressed to 75 lb. is 8 cents per 1000 cu. ft. of free air), the cost per hydraulic hp-hour is found to be 12.5 cents, and the cost of pumping 1000 gal. 3.3 cents, as against 1.93 cents for the motor-driven centrifugal pump. Mr. H. Gansslen cited a case which he had investigated where with a lift of 110 ft. estimates showed that it would take as much steam to lift 250 gal. per minute with an air-lift as it took with a deep-well pump.

Prof. D. W. Mead, the well-known authority on waterworks engineering, said that the deep-well centrifugal pump described in the paper seemed to be one of the most satisfactory solutions for deep-well work where the quantity of water to be pumped amounts to 250 to 1000 gal. per minute. Where smaller quantities are to be pumped other types of machinery can perhaps be used to greater advantage. The wear was very small on deep-well centrifugal pumps, which was a point very strongly in favor of that class of machinery. Both Messrs. J. L. Hecht and Perry H. Hedrick agreed that the best results were obtained with an air-lift when the water flows from the well in a steady stream mixed with the air. The formation of piston-like layers of air and water was not indicative of the best results and would occur when the submergence is insufficient or when the submergence is proper and the air supply either too large or too small. With the correct submergence and with the proper amount of air supply at a proper pressure and admitted under proper control, the flow of water from the well was practically a continuous stream.

Electric Service of the Fitchburg Gas & Electric Company.

BY WILLIAM H. STUART.

FITCHBURG, MASS., is a manufacturing city with a population of about 35,000, and the center of population of 110,000 people in a radius of 12 miles, connected by railroad, trolley or macadam highway, and in some cases by all three. Its manufactures are of a very diversified character, there being in Fitchburg no less than 50 industries each producing a separate and distinct product on a large scale. The most important are saw works, the largest in the world; next in order are works for the manufacture of engines, paper, shoes and ginghams. The manufactured products amount to $16,000,000 annually. One feature of Fitchburg's industries is that they are owned locally.

The first electric light station was established in Fitchburg in 1883 by the Wachusett Electric Light Company. The plant and office were located in a small brick building on Water Street, opposite Crocker Street. In 1889 the Wachusett Company was purchased by the Fitchburg Gas Company and the electric station removed in that year to a new station built near the gas works. In 1902 the business had outgrown this station and a new and up-to-date plant was built and equipped with three generating units with a capacity of 3,000 horse-power. The first electric motor used in Fitchburg was installed by the Sentinel Printing Company, in June, 1892; it was a 15-hp motor and replaced a steam engine used for operating the printing presses.*

The present plant is located in South Fitchburg and comprises three brick and two wooden buildings. In one of the former is located the station proper, the others containing storeroom, coal space, stables and repair rooms.

The generating equipment consists of five Stirling boilers of 258 horse-power each, and three McIntosh & Seymour engines of 600, 900 and 1500 horse-power respectively, direct-connected to three General Electric three-phase generators of 400, 600 and 1000-kw capacity. The current is generated at 2200 volts, which is transformed for power to three-phase, 550 volts, and for incandescent lighting to single-phase, 110 and 220 volts.

The excellent arrangement of the apparatus in the station and the cleanliness of the surroundings have made the plant one of Fitchburg's industrial show places. The main engine and dynamo room is on the first story of the largest station building and is reached from the street by an iron stairway. On one side of the room is located the switchboard, which has three generating panels, four line panels, one station and one exciter and regulating panel, making nine in all. The board is of dark slate with a base finished with dark yellowish tiles, and the instruments are nickel plated. The three generating units are railed off, and all pipe connections are painted white. The floor of the room is covered with heavy cork, varnished. Passageways have a covering of rubber runners. The illumina-

*An account in detail of the motor service of the Fitchburg plant, by Mr. A. H. Kimball, the superintendent, is given elsewhere in this issue.

tion of the station at night is from lighting units suspended from ornamental arms.

The ashes are used for filling. The coal is brought in on a railroad spur and dumped in a pile as needed. An industrial railway runs from the coal heap to the boilers.

The street mains are run overhead on poles with the exception of those on Main Street. The company realizing that in the future the city government might make a request that the mains in this street be placed under ground, voluntarily constructed a subway two miles long. Transformers are used individually, and are mostly on the rear of buildings, as the majority of connections are made from the rear rather than the front. The poles of the company are numbered by means of a small steel plate, bearing the name of the company and the number of the pole nailed to the pole about 9 ft. from the ground. A station employee in an auto runabout covered the territory thoroughly and rapidly. The primary circuits, arc and incandescent, are tested out four times each day.

The meter department is in a comfortable and thoroughly equipped room where all meters are tested when received from the manufacturers and given a number and placed in stock. On complaints of high bills and a request that meters be examined and tested, a portable testing set is used and the meter tested in circuit in the consumer's presence. All meters are tested, cleaned and regulated once a year. The meter department is operated by two men. The meters are read every month by readers sent from the office. For reading, there are meter indexes on cards which contain name of customer, address, meter number, constant, date set and ledger information. The gas and electric meters are read by the same set of men, for which service there are eight men.

The force required to operate the station is composed of a chief engineer, three engineers, three oilers, three firemen, two coal handlers, one foreman and four linemen. The company for two years has had two small auto runabouts which are used both night and day and have become indispensable.

The lighting load is composed of commercial incandescent and arc and street arc and incandescent lighting. The city contract for street lighting calls for 322 arcs of 2000 candlepower at $100 per year, and 83 incandescent lamps of 32 candlepower at $30 per year, lighted all night. The commercial consumers use about 110 arc lamps and the number of incandescent lamps of 16-cp equivalent is about 16,000. The total number of kw-hours generated during the year ending June 30, 1906, was 2,835,687, of which amount 631,200 kw-hours were for street lighting, the balance being used for power and for commercial lighting. During the year ending June 30, 1907, the total output was 3,240,618 kw-hours, of which 1,358,918 kw-hours were in lighting load.

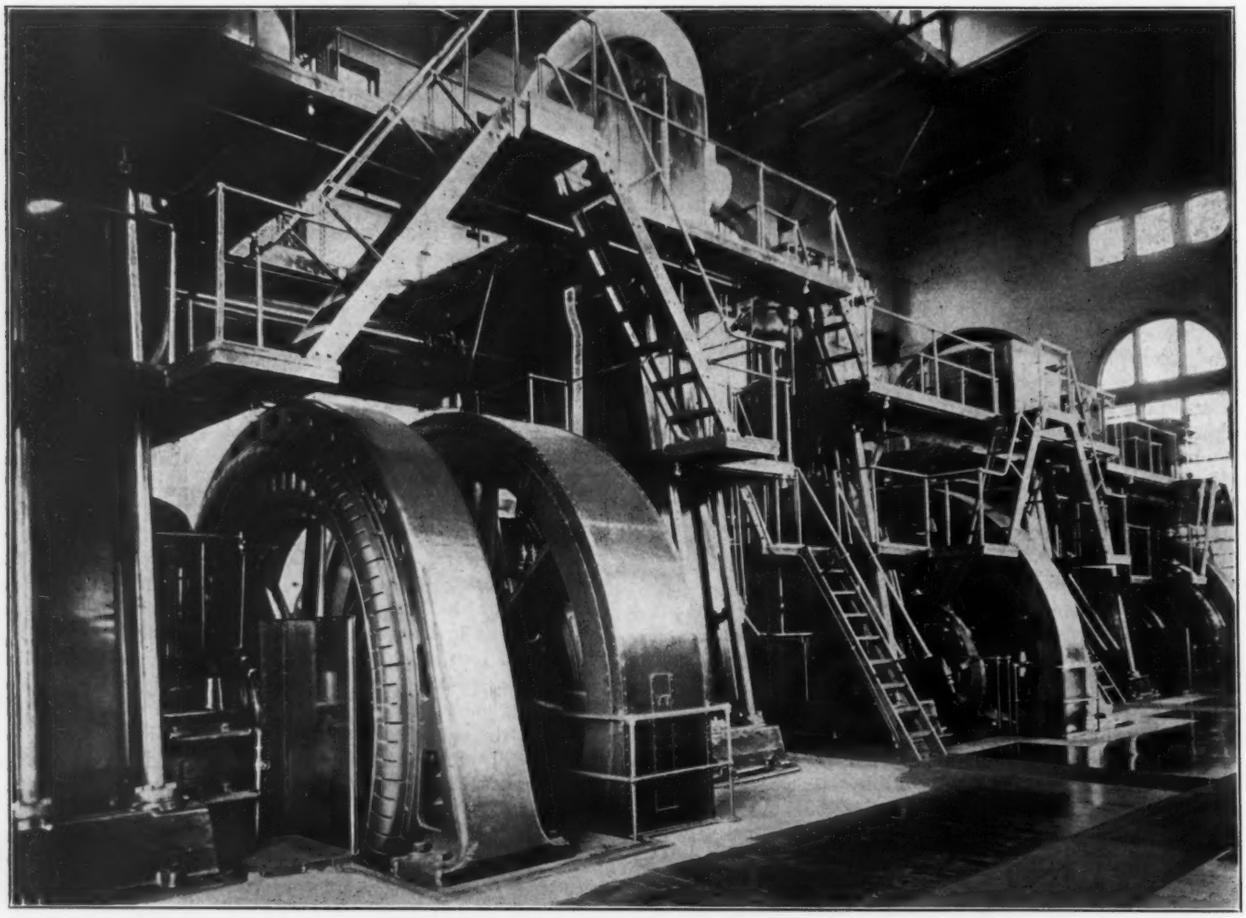


FIG. I.—VIEW OF INTERIOR OF STATION OF FITCHBURG GAS & ELECTRIC COMPANY.

An interesting and comprehensive account of the power business in Fitchburg, the methods used and the results obtained, is given in an article entitled "Electric Power Business in New England" in the November issue of this journal, where it is pointed out that applications of electric power have been made to about 60 separate uses.

The office of the company is located on Main Street, where it occupies the ground floor of a modern building and has two large show windows. Overhead across the entire front of the building is a large sign reading, "Fitchburg Gas and Electric Company," and just below this is another sign of smaller dimensions reading "Electric Power." The signs are operated by a flasher, and at night show up very nicely. The show windows are well lighted and contain exhibits of various electric and gas fixtures and appliances. The electrical exhibit at present is one composed of small motors showing their adaptability for general use. The office contains an elaborate show

room. A large wall showcase with sliding glass doors contains every conceivable heating and cooking appliance. Next to this is a well-arranged space on the wall which is used for exhibiting various styles of lamps and shades. There is also a space allotted for wall lamps and fancy small brackets and arms containing one or more lamps. On the opposite side of the room there are motors of various sizes arranged on a platform raised from the floor. In the basement various rooms have been portioned off and are used as meter rooms, stock and storerooms for arc lamps, motors, wire, fixtures, etc.

The company wires and sets up motors ready to run for a consumer, and if after a fair trial the motor is not wanted the only charge to the consumer is for current consumed. It furnishes arc lamps and keeps them trimmed and in good repair, but does not furnish free incandescent lamp renewals. Outside wiring necessary to connect a service is at the expense of the customer and is charged as service connection. Meters are set and removed without charge.

In the daily papers advertising cuts and descriptive matter is used. Descriptive circulars and follow-up letters are used in advertising campaigns and have brought results. An illustrated descriptive pamphlet entitled "Facts Regarding Electric Power in Fitchburg" has been used to good advantage. A neat little folder of buff color, closed with a red seal and with the wording, "A Few Points for Careful Housewives" on the outside, contains a package of sewing needles, representing the physical points, and opposite are points about electric flat-irons. All of the advertising matter is arranged in attractive and catchy forms.

All current is sold by meter. The rates for incandescent and arc lights are as follows:

Basic rate, 20 cents per kw-hour, subject to the following discount for bills paid on or before the 20th of the month on which such bills are rendered:

Kilowatts metered.	Discount, per cent.	Net rate per kw-hour.
Less than 25 kw-hours per month	5	$0.19
25 to 50 kw-hours per month	10	.18
50 to 100 kw-hours per month	15	.17
100 to 150 kw-hours per month	20	.16
150 to 200 kw-hours per month	25	.15
200 to 250 kw-hours per month	30	.14
250 to 325 kw-hours per month	35	.13
325 to 400 kw-hours per month	40	.12
400 to 500 kw-hours per month	45	.11
500 kw-hours and over per month	50	.10

The minimum monthly charge is $1 for each meter set. The minimum monthly charge for arc lamps is according to the length of contract as follows:

One year or more	$2 per lamp per month
Six months or more	$3 per lamp per month
Three months or more	$5 per lamp per month

The rates for power are as follows:

	Cents per kw-hour.
Less than 100 kw-hours per month	10
100 to 200 kw-hours per month	9
200 to 300 kw-hours per month	8.5
300 to 400 kw-hours per month	8
400 to 500 kw-hours per month	7.5
500 to 600 kw-hours per month	7
600 to 800 kw-hours per month	6.5
800 to 1000 kw-hours per month	6
1000 to 1200 kw-hours per month	5.5
1200 to 1400 kw-hours per month	5
1400 to 1600 kw-hours per month	4.7
1600 to 1800 kw-hours per month	4.4
1800 to 2000 kw-hours per month	4.2
2000 to 2200 kw-hours per month	4
2200 to 2400 kw-hours per month	3.8
2400 to 2800 kw-hours per month	3.6
2800 to 3200 kw-hours per month	3.4
3200 to 3600 kw-hours per month	3.3
3600 to 4000 kw-hours per month	3.2
4000 to 5000 kw-hours per month	3.1
5000 kw-hours and over per month	3

The minimum monthly rates for the motors range as follows: $1 for ¼ hp, $3 for 1 hp, $8 for 5 hp, $15 for 10 hp, $20 for 15 hp, $22.50 for 20 hp and $1 per hp for 25 hp or over. A discount of 10 per cent is allowed on all bills paid on or before the 20th of the month.

The officials of the company are: President, Mr. Herbert I. Wallace; treasurer and manager, Mr. H. F. Coggshall; superintendent, Mr. A. H. Kimball; chief engineer and electrician, Mr. H. L. Battles.

Electric Power, Its Progress and Possibilities.

By A. H. Kimball.

In the early days 15 or 20 years ago, central stations outside of the larger cities did not run through the daytime and their hours of starting and stopping varied according to the time of the year and weather conditions. In summer, the station started about 6 p. m. and was shut down the next morning after the street lights went off at from 4 to 5 a. m. As the days began to shorten, however, the running hours of the station began to lengthen, till the schedule had changed the starting time to about 3 p. m. and the shutting-down time to about 8 a. m. the next morning. It was a purely lighting load, with the load factor exceedingly low and the prices for lighting correspondingly high, and these conditions would to a great extent exist to-day if it had not been for the introduction of electric power.

With the advent of the electric motor as a commercial piece of apparatus it was necessary to run the station all day in order to obtain electric-power business. It was a losing game for the station to begin with, and in the case of the Fitchburg, Mass., station, where we started with a 15-hp motor in 1892, it was years before our electric-power income was enough to cover the station labor.

The year 1900 saw 110 hp in motors connected to our system, which was then 500 volts direct current, and we began to realize what might be done with electric power if we only had a modern

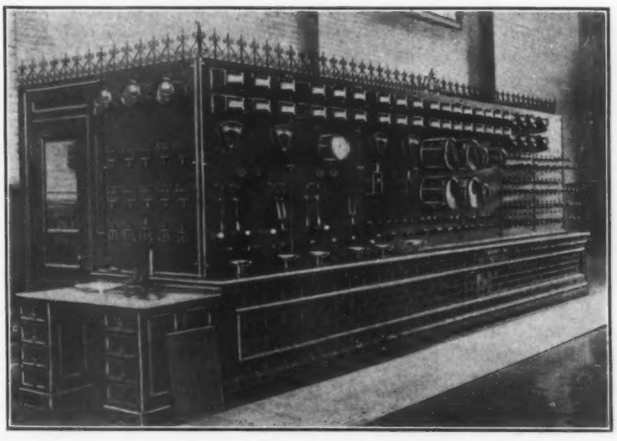


FIG. 2.—SWITCHBOARD IN STATION OF FITCHBURG GAS & ELECTRIC COMPANY.

station with capacity to handle electrically the numerous steam-operated plants in this city. After careful investigation we decided to build such a plant, and ground was broken early in 1902, with the result that on July 1, 1903, we started a new and modern station with three-phase, 2300 volt, 60-cycle generators having a capacity of 1000 kw. About July 1, 1907, we doubled this capacity, and have to-day a 2000-kw station, comprising units of 400, 600 and 1000 kw.

Electric power has made this possible, has given continuous electric service of all kinds to the customer, has largely influenced the reduction in the cost of electric lighting, and is and will be the salvation of many of the electric-lighting plants of to-day.

At the time of starting our new station we had 246 hp in direct-current motors connected to our system, which we rapidly changed to three-phase, 550 volts. This amount of electric-power business had been acquired in 11 years, a pretty poor showing when we look back on the record from to-day. We realized, however, that this slow growth was due to several causes:

First, the electric-power business was new and undeveloped, and the price of motors and the rates for current were high. Second, data regarding practical operation were lacking, and our arguments to prospective customers carried little weight for want of conclusive facts.

I therefore determined to obtain all possible data on this subject, both as to station output and the operation of the customers' motors, and make use of the information in getting new business. A list of the power customers was first made and the necessary data compiled under the following headings.

The accompanying table gives under these headings a partial list of our power customers, giving the data for six months ending July 1, 1907.

From these data can readily be obtained, if desired, the amount paid by the customer for six months and the rate paid per horse-power used. The data under these last headings we do not carry out in printed form when soliciting power business, as it would not be advisable to make a public exhibition of the amounts paid by our individual customers.

The data are based on six months' operation, 25 working days to the month, and 10 hours per day, which in our particular case is a very close average. This gives us practically all of the customer's working conditions, except his variable load indications from minimum to maximum, which could only be accurately obtained by a three-phase, curve-drawing wattmeter or by taking readings at short intervals from an indicating or recording wattmeter.

As our power business increased these data became very valuable in showing the amount of power actually used by different classes of work and manufacturing industries. A study of the data will be exceedingly interesting to solicitors for electric power as showing what results prospective customers engaged in similar classes of work may reasonably expect. They show conclusively that the total horse-power in motors which the customer has installed has comparatively little bearing on the size of his electric-power bills.

There are two particularly strong points that should be borne in mind when soliciting electric-power business, namely, the possibility of greatly reducing the power actually required to do the work, by eliminating friction due to shafting, connections, etc., and by an intelligent installation of electric motors; and, second, the saving a customer can make with a metered rate where the character of his work is intermittent.

Take, for example, customer No. 3 with 25 hp in motors, with an average use of 20.84 hp, or 80 per cent, of his power installation. This customer has two motors, one of 15 and one of 10 hp, belted to two lines of shafting, from which all his machines are belted. We made a test of this installation recently, the friction load being taken one Saturday afternoon after the shop had shut down and a reading of the customer's recording wattmeter also taken. An accurate record of his running time for the next week was kept, and his meter again read. After deducting the known power used in friction for that time, it was found that out of the total kw-hours used for the week only 24 per cent were used for the actual work and 76 per cent lost in friction.

Compare this with customer No. 7 with 28½ hp in motors, with an average using of 12.50 hp, or 44 per cent, of his power installation. This customer has two 10- and one 7½-hp motors belted to shafting, and a 1-hp motor belted direct to an individual machine. This is a new and modern shop, recently built without engine house, boiler house, or power chimney, and was designed to operate by electric power. On account of the large number of tools and machines to be operated (most of them small and some 60 in number), it was not deemed advisable to attempt to run them with individual motors. The shafting was of the best, and was installed with a view of eliminating all possible friction. A test of this installation on a week's run showed the kw-hours consumed in friction to be 55 per cent of the total kw-hours used.

Now compare these two customers with customer No. 35, with 95 hp in motors, with an average using of 20.76 hp, or 25 per cent of his power installed. This customer has the advantage of No. 7 in having fewer and larger machines to operate, and was induced to adopt a complete system of individual drive, and practically cut out every foot of shafting except a few counters. His installation comprises some 30 motors, averaging from ½ to 10 hp, with a switch at every machine. He has no friction loss except what is in the motors themselves and the machines they operate, and his operating efficiency is the highest obtainable. His average motor installation cost was considerably in excess of the other two, but was offset to a certain extent by their investment in shafting. The efficiency in operation of No. 35 has been sufficient to pay the whole installation cost in a comparatively short time.

The data from other customers are all interesting as showing the continuous or intermittent character of their work. Take No. 9 running a cash system. This is practically a continuous load, and used 84 per cent of the power installed. No. 11 is used for sawing wood, which is very intermittent work, and used only 10 per cent of the power installed.

The table gives practical illustration of the actual running conditions as they exist in different classes of work, and will very materially assist in convincing a prospective customer that electric power is efficient and cheap (if the rates are right).

One day last summer a man telephoned us that his engine had broken down and asked how quickly we could furnish him with electric power. We carry in stock for immediate delivery motors in all sizes up to 50 hp, and as he claimed 50 hp was necessary for his needs, we had him connected and running the next afternoon with a 50-hp motor belted to his main shaft. He was a man we had approached several times to introduce electric power, but without success, and here was an excellent opportunity to demonstrate what we could do. In two successive days we made eight tests to determine the power he was using, with the following results:

On the first day four tests showed: 34.1, 31.8, 34.5 and 30.5 hp; and on the second day, 32.2, 31.4, 30.5 and 32 hp, or an average of 32.12 hp being used. We also installed a recording wattmeter, which registered in two days of 10 hours, 470 kw-hours, showing an average of 31.3 hp, compared with 32.12 hp obtained by the indicated readings, a very close comparative record.

On each day between the hours of 12 and 1, when the work

THREE-PHASE POWER RECORD.
January 1, 1907, to July 1, 1907.

	Name of Customer.	Hp installed in motors.	Kw-hours used in six mos.	Rate per yr. per hp installed.	Average hp used	Ratio of hp used to hp installed, per cent.
1	Machine shop...	12½	6,401	$50.83	5.69	46
2	Printery	3	763	41.22	.678	46
3	Machine shop...	25	23,450	53.59	20.844	80
4	Roast'g and grinding coffee.....	5	1,193	37.46	1.05	21
5	Grain elevator...	86	32,180	22.63	28.6	36
6	Sawing wood....	3	*358	22.08	.318	10
7	Machine shop...	28½	14,070	33.58	12.507	44
8	Woodworking ...	2	90	22.00	.08	4
9	Cash system.....	1	944	152.78	.839	84
10	Printery	5	1,299	43.15	1.155	23
11	Sawing and splitting wood.....	5	567	20.29	.504	10
12	Printery	2	454	42.38	.404	20
13	Making shoes....	3	278	19.68	2.47	8
14	Making yarn....	75	13,070	12.19	11.618	16
15	Foundry	86	18,790	13.28	16.702	19
16	Sawing wood....	5	376	18.25	.334	7
17	Foundry	30	13,040	30.38	11.588	39
18	Foundry	9	4,230	55.00	3.76	42
19	Machine shop....	10	4,159	48.66	3.697	37
20	Confectionery ...	2	166	24.30	.147	7
21	Machine shop....	5	1,284	39.87	1.141	23
22	Creamery	3	151	18.00	.134	4
23	Printery	10	763	16.80	.678	7
24	Charging batteries	5	1,961	57.01	1.743	38
25	Making yarn....	90	81,830	40.69	72.738	80
26	Foundry	9½	5,018	58.27	4.46	47
27	Gingham mfg....	305	219,736	25.94	195.32	75
28	Gingham mfg....	150	85,460	20.51	75.964	51
29	Gingham mfg....	260	195,100	27.01	173.422	67
30	Ice cream.....	2	215	26.37	.191	10
31	Optician	1	98	32.40	.0871	8
32	Blacksmith shop..	1	35	32.40	.031	3
33	Printery	15	5,982	41.61	5.316	35
34	Saw mfg.....	164½	56,080	16.76	49.848	30
35	Machine shop....	95	23,360	14.02	20.764	25
36	Machine shop....	3	258	18.30	.229	8
37	Sawing and splitting wood.....	5	871	27.87	.774	15
38	Sawing and splitting wood.....	5	336	17.28	.298	6
39	Sausage mfg....	3	7,445	73.72	1.284	43
40	Sawing wood....	5	126	6.48	.11	2
41	Printery	3	565	36.13	.502	17
42	Lumber yard....	47½	13,680	19.72	12.16	26
43	Grinding coffee..	½	91	43.20	.088	18
44	Roast'g and grinding coffee.....	5	330	17.28	.293	6
45	Waste compress'g	9½	958	16.93	.851	9
46	Elevator	25	6,150	23.20	5.467	22
47	Elevator	10	1,065	10.02	.947	9
48	Machine shop....	2	154	21.60	.137	7

had stopped, we took indications to determine the friction load, which we found practically the same on three tests and amounted to 23.4 hp. This showed that only 7.9 hp was required to do the actual work and that 73 per cent of the total power required was consumed by friction. Our demonstration convinced the customer beyond a doubt that we could, with

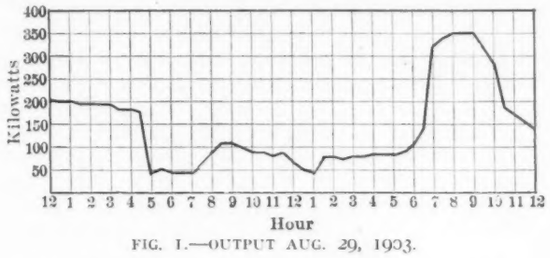


FIG. 1.—OUTPUT AUG. 29, 1903.

a number of motors properly located, furnish him with electric power for less money than he could operate by steam.

I cite this case as an example of the possibility of a practical demonstration of this kind to show the customer on his own premises what can actually be done with electric power. We have made a number of demonstrations of this kind with the most satisfactory results.

July 1, 1903, was the beginning of our fiscal year, and also the date of starting our new station, and we determined to

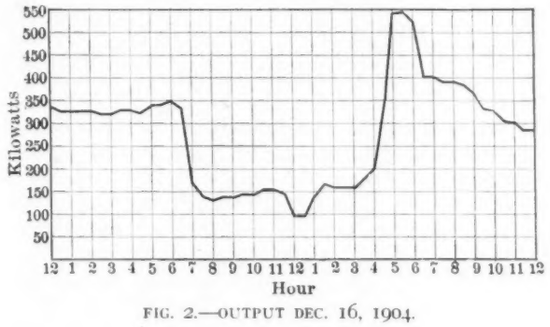


FIG. 2.—OUTPUT DEC. 16, 1904.

keep some accurate records of our station operation. Our electric-power business at that time amounted to 20 per cent of our total output. Our load factor for the previous year was unknown, and also most of the essential data relating to economic operation.

Curve sheets 1, 2, 3, 4 and 5 indicate the total output from

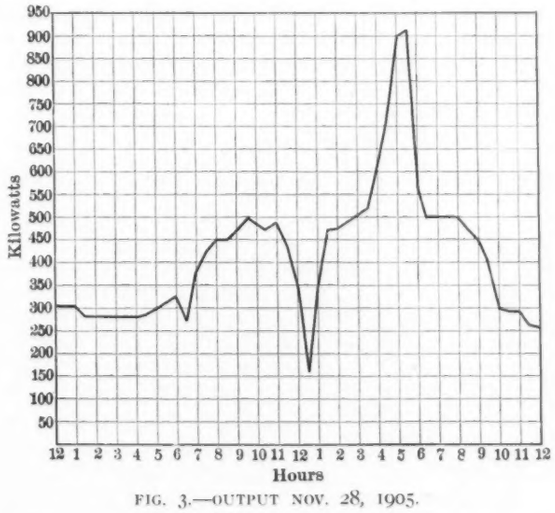


FIG. 3.—OUTPUT NOV. 28, 1905.

the station on those days for both lighting and power, and the growth shown is nearly all due to electric-power business. This had a peak load of 95 kw, with an output of 600 kw-hours on Aug. 29, 1903, and a peak load of 800 kw, with an output of 9000 kw-hours for July 31, 1907, which was 80 per cent of the total station output for that day.

Our station load factor for the year ending July 1, 1904, was 15.9 per cent, and for the year ending July 1, 1907, 34.3 per cent, which increase was due almost wholly to electric power.

The first running year of our new station, which ended July 1, 1904, showed an average station motor-load equal to 21 per cent of the total horse-power in motors installed. This showed

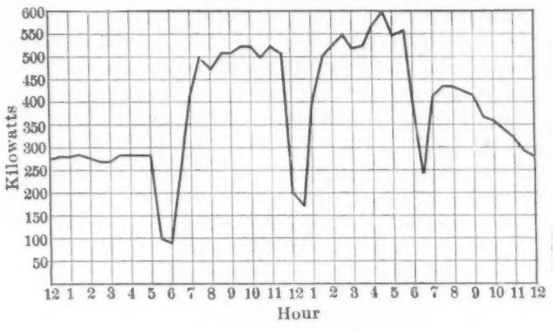


FIG. 4.—OUTPUT MARCH 28, 1906.

at once the intermittent character of the load at that time, which condition was gradually changed by the addition of cotton mills and other consumers requiring more continuous power and has brought the electric-power load factor for the last year up to 38 per cent.

Some fears have been expressed, and with good reason, that the acquirement of a power business would bring on a peak load in the winter months that would overload the station lighting apparatus when the lighting and power loads overlapped each other. Our peak load in 1904 was 263 per cent higher than our average day load. In 1905 it was 103 per cent, in 1906 it was 75 per cent, and in 1907 50 per cent, and only 22 per cent higher than our highest day load.

If electric-power business is to be had it is worth going after, and it will pay to enlarge a plant in order to handle it. If it can be obtained in large quantities it will soon outrival the lighting business and make necessary a station capacity that will set at rest all fears of a peak load.

With a largely increased output from a station, the cost to manufacture a kw-hour would be reduced. This saving not only applies to new business, but to old business as well, and makes possible reductions in rates, which are very acceptable to customers and tend to stimulate and increase the business in all its branches.

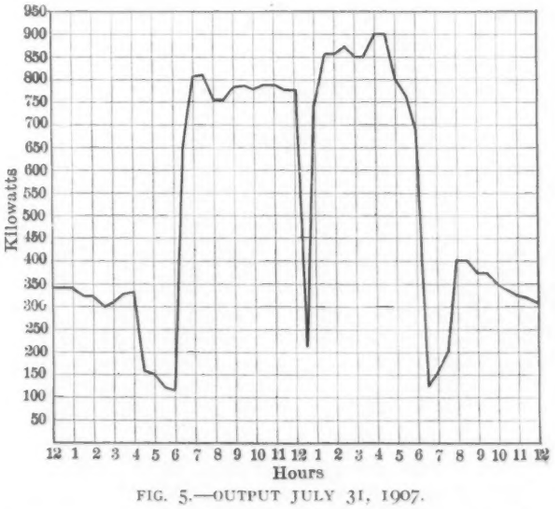


FIG. 5.—OUTPUT JULY 31, 1907.

Electric power is far from being fully developed, but it is growing fast, and its economies are being better understood. There is no question in my mind but that electric power can be produced from a central station in large quantities and be distributed to customers, both large and small, for a lower price than they can make it individually.

Electrical Equipment of an Iron Foundry.

The electrical equipment of a successful iron foundry furnishes one more example of the range of adaptability of electric power. Nineteen motors, with an aggregate rating of 200 horse-power, are used in the Providence foundry department of the General Fire Extinguisher Company, and the motors vary in size from 2 horse-power, which is the rating of a motor on a single rattler, to 40 horse-power, the rating of a motor driving a Roots blower. The foundry in question was not originally laid out for electric drive, so that a more economical arrangement could have doubtless obtained had electricity been used at the start.

Considering the installation with relation to the logical development of the product, the sand-mixer is the first machine to call for attention. The sand for the cores is received in the basement, where it is conducted by a chute to the sand-mixer. This machine is belted through a short countershaft to a 5-hp motor, and a test made on this mixer shortly after its installation showed a consumption of about 3.34 horse-power with the mixer fully loaded. The sand, after passing through the mixer, is discharged into a receptacle whence it is taken by a bucket conveyor to the core-making room on the second floor. The motor on the sand conveyor is rated at 3 horse-power, and is shunt wound. Under normal conditions of operation the power required ranges from 0.8 to 1.25 horse-power, depending on the speed with which sand is fed into the buckets.

An Ingersoll-Sergeant compressor furnishes air for 45 molding machines, two shakers and five hoists. This compressor also supplies air for cleaning the motors; a small pipe being run to each motor, where a cock is provided for the attachment of a flexible tube with nozzle. The compressor is driven by a 30-hp Westinghouse shunt-wound motor through a silent chain drive. A recent test on this machine showed an input of 29 horse-power.

The foundry is equipped with two cupolas, 70 in. and 76 in. outside diameter, respectively. The blast for the cupolas is supplied by a No. 6 Roots blower and a No. 5 Baker blower. The larger cupola and the Roots blower are used under ordinary conditions; the other set being reserved for use in large melts and for emergencies. Both blowers are installed in rooms adjacent to the charging floor, and the pipes are so arranged that either cupola may receive air from either blower. The length of pipe from the blower to the cupola is about 35 ft. The Roots blower is driven through a rawhide pinion gear by a 40-hp General Electric shunt-wound motor and the Baker blower is driven by a 30-hp motor of the same style and make. The input to the motor driving the Roots blower is given in Fig. 1.

The rattlers are divided into three sections, and each section is driven by a separate motor. Two of the sections comprise three rattlers, and the third section comprises five rattlers. The rattlers are all 57 in. long by 36 in. in diameter. The larger section is driven by a 15-hp Crocker-Wheeler shunt-wound motor, and the other sections are driven by a 15-hp Holzer-

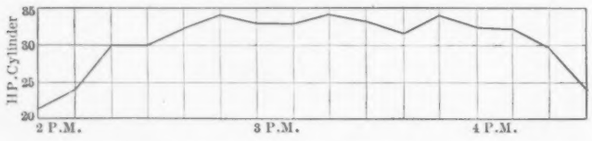


FIG. 1.—INPUT TO MOTOR DRIVING BLOWER.

Cabot and a 10-hp Westinghouse motor, respectively. Under average conditions each rattler requires about 2.3 horse-power. The dust is exhausted from the rattlers by a 36-in. fan operated at 1000 r.p.m. by a 7½-hp Holzer-Cabot motor. A test of the exhaust fan showed an input of 4.2 horse-power. The motor and fan are belt-connected. The motors for the rattlers and fan are installed in a small room adjoining the machines they operate and on a level with the shafting. The motors are controlled by switches and rheostats installed in wall cabinets at a convenient location for the men tending the rattlers.

The grinders, four of which are motor-driven, and five of which are belt-driven, are equipped with emery wheels. The motor-driven grinders are 5-hp Holzer-Cabot machines, with two 17-in. x 3-in. emery wheels mounted on the armature shaft. The belt-driven grinders also have two emery wheels. The foundry is well ventilated throughout by five exhaust fans. These are operated by motors ranging in rating from 2 to 5 horse-power.

The carpenter and pattern shops, both of which are equipped with electric motors, round out the installation. The carpenter

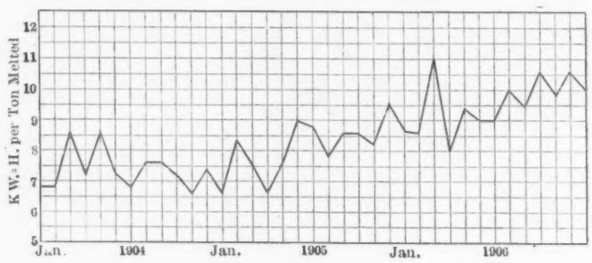


FIG. 2.—CURVE SHOWING CONSUMPTION OF ENERGY PER TON OF METAL MELTED.

shop has a 2½-hp motor, which drives a 36-in. band saw, a vertical drill, a circular saw and a grindstone. The pattern shop has a 10-hp motor driving a main shaft to which are connected by countershafting two circular saws, a 36-in. band saw, several small lathes and a tool grinder. When all the machines are in operation they require an input at the motor of 8.3 horse-power.

The output of the foundry consists of small castings, nearly all of which are rattled and ground. The average consumption of energy per ton of melted metal for the years 1904, 1905 and 1906 is shown in Fig. 2. This includes the energy used for all purposes, although some of the motors, such as those connected to exhaust fans, have no connection with the output. In a foundry where the output consists of large castings the energy consumption per ton of metal melted would be less.

Although the direct-current motor is not so well adapted to foundry work of this kind as the induction motor, because of the dust and dirt, the installation in this instance has given entire satisfaction. If the plant were equipped with a belt drive throughout, it is estimated that from 40 to 50 horse-power would be required to drive the shafting alone. The foundry is a busy one, turning out a high grade of work; and since it has been working continuously, the test of the motors has been thorough. All motors, except those on the grinders, are of standard types, and the energy for the installation is taken from the 500-volt, direct-current mains of the Narragansett Electric Lighting Company.

The Electric Motor Load from the View Point of Central-Station Service.

By Charles K. Nichols.

When the first central stations began operation for the distribution of electric current, it was to supply a lighting load exclusively, and for several years motors were not regarded from a central-station standpoint. As the motor became more mechanically perfect, however, the central-station manager began to realize the possibility of developing a day load which would increase the general efficiency of his plant and reduce the cost per kw-hour. With a strictly lighting load the curve plotted from the station output will rise sharply between the hours of 4 and 6 p. m., depending upon the season of the year, with an extreme peak between 7 and 7:30, then gradually drop as evening advances. For the remainder of the 24 hours the plant, if operated, will be practically without load.

As the increase in kw-hours sold per dollar invested in plant means a lower average cost per kw-hour, the importance of filling the low portion of the load curve is obvious. Of course,

the ideal station curve would be flat, but as it is not possible to get away from the evening peak, and as the capacity of the plant must be determined by this, for the greatest possible economy of operation the day load must be brought up as near this peak as possible, but not so as to overlap it. To prevent this overlapping of the light and power loads, it has been found advisable in some stations to make special concessions to large consumers who will agree to close down their plants at some stated time, just before the evening load comes on. This is especially necessary during the winter months, so if the customer will agree not to use current between the hours of 4 and 8 o'clock during the months of November, December, January and February, a very attractive rate may be made for large installations. With smaller customers, however, no stipulation of this kind may be made, for most of the minor industries close down daily at about 5 o'clock, before the time of the extreme peak.

The extent of the power load will to a very large degree regulate the net income of the station, and to the development of this load should the attention of the central-station manager be turned. If the motors on the line are classified according to use it will in some cases be found that the capacity connected for elevators will head the list. This load, however, is not particularly attractive, and will show a smaller income per horsepower installed than any of the industrial applications. The load factor is low, and the instantaneous demand high, which may cause an undesirable fluctuation of pressure in the immediate neighborhood, especially if it be on the end of the line. Many stations have attempted to keep this starting current at a minimum by special elevator rates, which place a penalty on heavy inrush. It is not well to be too severe in this respect, for the success of the electric-elevator machine would be jeopardized if rapid acceleration were sacrificed for a low starting current. Generally speaking, this current will seldom be less than 100 per cent above the rated capacity of the motor, even in direct-current work.

Where electricity is installed for elevator work to replace steam power, we often find that instead of changing the system entirely from hydraulic to straight electric, a motor will be put in to drive the pumps, the starting and stopping of which will be governed by a pressure regulator or a float switch, depending upon the system used. An installation of this nature is not economical, and compares with the latest types of drum and traction elevators in kw-hours per car mile, as six or eight to three.

The printing industry may form a very fair portion of the power load, as the advantages to be derived from electric drive are especially evident in the pressroom, and printers have been very ready to adopt it. It is well in soliciting this business to talk to your prospect, not in kilowatt-hours, of which he will know little or nothing, but in power cost per thousand pages of newspaper or per 100 magazines. These costs can be determined by tests made upon other plants, and information of this kind will be a most valuable asset to the solicitor. As far as possible every line of manufacture should be handled in this way. It means nothing to the average layman to tell him that you will supply him with current for 10 cents per kw-hour. He cannot see why his load factor should be 50 per cent instead of 100 per cent, but he *will* understand the relation of power cost to output, and if he is shown that his neighbor's electric power costs so many cents per 1000 impressions with presses and work similar to his, he will have some tangible evidence upon which to base his comparison.

The machine shop and wood-working plant form a very attractive load because of the practice of installing, to a large extent, individual motors, or small units for group drive, thus eliminating the pressure variation which might be evident where a single large motor is installed, demanding a high starting current. One great difficulty has been found in securing the wood-working business, owing to the disposal of waste. In most localities there is little or no chance to sell sawdust and shavings, and the customer must pay for their removal when operating his plant from central-station supply. If running his own steam plant and burning this waste under the boilers, a marked reduction in the fuel bill is evidently made.

Within the past two years contractors have been turning their attention to the application of electricity in building construction work, and its use in this connection has developed rapidly. Hoists and concrete mixers may be operated more economically by electricity than by steam, and, when motor-driven, may be installed inside the building which is being constructed. This would be practically impossible if operated by steam engine, on account of the attendant smoke and heat. Electric hoists are often moved from floor to floor, as the building progresses, thus reducing the cable length to about half that with the hoists on the ground. Not only does the ease of extending the wires make this possible, but the uniform rotary motion of the motor reduces the vibration to a minimum. Other motor-driven machines used in this work are pumps, pile-drivers, air-compressors, forges, excavating shovels, cable-ways and portable drills. Objection is often made by the central-station authorities to the extension of the distributing lines for work of so temporary a nature, but in the majority of cases the finished building will use the current. If not, the contractor should guarantee that the service will be in use for at least three months, or the cost of the introduction of the wires will be charged to him.

In the larger cities the clothing industry will give a very fair portion of customers. There is a large field for motor-driven

FIG. I.—PORTABLE VACUUM CLEANER.

sewing machines, cutting tables and flat-irons. Although the units in this class of work are small, the number of customers is large, and the daily working hours long, making this a very productive load.

One of the most attractive openings for motor installation is in connection with refrigerating machines. These may be installed in butcher shops, cafés, drug stores, restaurants, dairies and residences, and operate very economically, especially where rates are made favoring long-hour users. In connection with refrigeration, the electrically-driven carbonating apparatus might be suggested. These machines may be installed in drug and confectionery stores, and the aerated water necessary for use in soda fountains supplied by them instead of from the familiar steel tanks.

Hoisting by electricity has become popular among coal dealers. Along the water-front of most of our cities many towers have been constructed and coal shipped to them in barges is hoisted and stored in bins to await distribution. From careful tests it has been found that with a 50-ft. lift the average cost is between 2 and 3 cents per ton hoisted, with current at 10 cents per kw-hour.

The various well-known appliances which have been noted are a few of those to which the central-station manager has given his attention—too much attention it may be, if such a

thing were possible. When I say too much attention, I mean that if the time spent in trying to secure a very difficult prospect who is operating a machine shop, perhaps, were devoted to working up a class of business in which motor-drive is still new, the results might be much more satisfactory from every

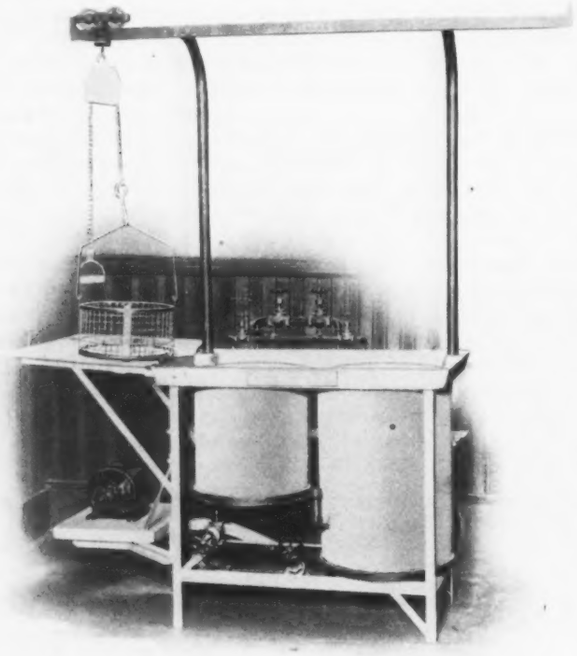


FIG. 2.—MOTOR-DRIVEN DISH-WASHING MACHINE.

point of view. In striving for the large and prominent installations we often lose sight of the smaller and less important possibilities—the grocer, the confectioner, the baker.

Efforts should be made to secure as far as possible from every lighting customer a power load at least equal to his lighting. If this were done the effect it would have on the daily load curve would be very manifest. It may seem that this would be out of the question, but no matter what the case may be, there is always an opportunity to secure some power business. Before going into the details of this smaller work it might be well to look over some of the possibilities for power where often nothing but light is considered. Some of the power applications on the circuits of the New York Edison Company may be tabulated as follows:

Residences.—Refrigerating machines; vacuum cleaners; buffing motors; small ice-cream freezers; dish washers; sewing machines; washing machines; meat-choppers; coffee-grinders; elevator; dumbwaiter.

Churches.—Motor for organ; ventilating fans; vacuum cleaners.

Bakeries.—Dough-mixers; egg beaters; cake cutters.

Confectioners.—Carbonator; ice-cream freezer, candy puller.

Butcher Shops.—Refrigerating machines; meat choppers; sausage machine.

Groceries.—Coffee mills.

Theaters.—Vacuum cleaners; pump; motors for curtain; ventilating fans.

Cafés.—Refrigerating machines; beer pumps.

Garages.—Charging posts; compressors.

Stables.—Horse groomer; horse clipper.

These are a few instances where power may be most successfully recommended among customers which are usually considered for lighting entirely. The advantages of motor-drive are just as evident here as in other cases that might be cited, and if these advantages are made clear the customer is often eager to use some, if not all of them.

Vacuum cleaners have met with great success, not only in public buildings, but in residences as well. Two general types are in use—one which is permanently installed in the cellar, with a riser through the building, and with conveniently located outlets to which the sweepers are attached. The other is a small portable machine which may be moved from room to room as the cleaning progresses. It is estimated that a broom will remove about 5 per cent of the dirt from a room, while the cleaner will take up about 95 per cent. The broom stirs up the dust particles, which soon settle, but the vacuum apparatus removes them entirely. The cost of operation is low, lower than if cleaned by hand, when we take into consideration the thoroughness with which the work is done.

Another use for the motor in residences is in connection with the washing machine. This machine is operated by ⅛-hp to 1/12-hp motor, and it is said will finish an average-sized wash in about an hour at a cost of from 2½ to 3 cents for power. The motor-driven ironer is also used for domestic work. With it the ironing may be done in about one-fifth to one-tenth of the time required when it is done by hand.

Buffing and polishing motors will reduce labor to a great extent, as the houshold silver can be cleaned in a few minutes with one of these devices, better than if a much longer time is spent with the common polishing cloth. Electric dishwashers, too, are often installed in private residences. The usual type of this machine consists of two tanks and a wire basket suspended over them on a trolley which allows this basket to be lowered into either tank. In the first tank is an agitator in the form of a fan and driven by a small motor. Hot water is admitted into the tank and the basket filled with dishes is lowered into it. The fan, forcing the water against the dishes, soon cleans them. They are then run through the second, or rinsing tank, and immersed in clean, hot water for a few seconds; they are raised from this, removed from the basket for drying, and the basket is ready to repeat the cycle. This machine will wash dishes at the rate of 2200 pieces per hour, while the larger hotel sizes have a capacity as high as 6000.

Small electric elevators are now popular in residences. These machines are built for two, three or four persons. Their operation is entirely automatic, controlled by push buttons in the car, also at each floor, and is something as follows: A person

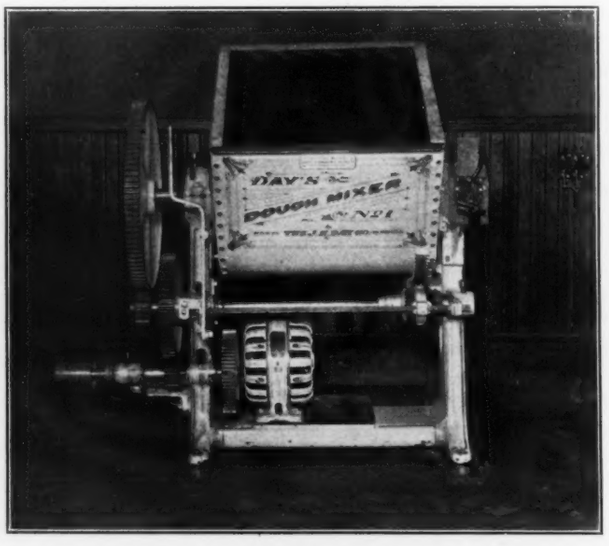


FIG. 3.—ELECTRICALLY-DRIVEN DOUGH MIXER.

opens the door at the first floor, let us say, and enters the car, closing the door behind him. Perhaps he desires to go to the third floor, so he pushes button No. 3. With no further action on his part, the car ascends to that floor and stops. He may then open the door and step off. Care should be taken to close the door again, as the car cannot be moved while the door is open, nor can the door be opened unless the car is at that floor. The door being closed and the elevator not in operation, it can be

brought to a floor by merely pushing a button at the side of the shaft, and at that floor it will stop automatically. This may be considered as one of the luxuries which electricity brings to the residence.

In churches there is always a chance to install a motor for

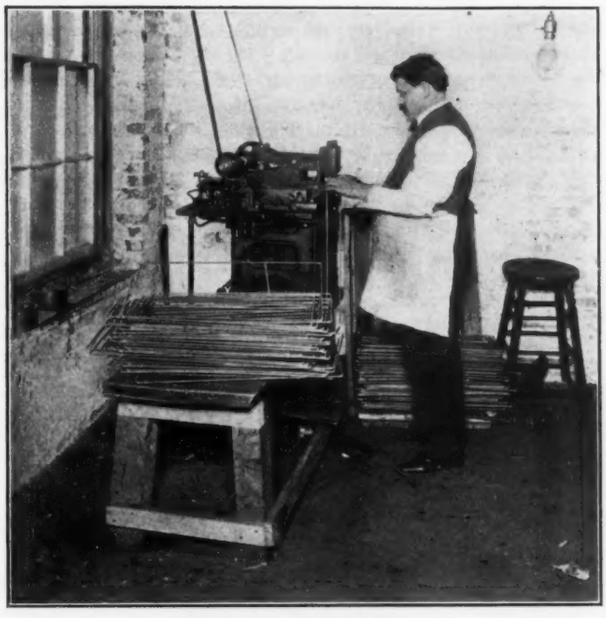


FIG. 4.—ELECTRIC WELDER.

operating the organ bellows, motors for ventilating fans, or a vacuum-cleaning outfit.

The bakery has but recently found that electric power is not only cheaper than hand work, but that the quality of the output is more uniform, the time required for each operation is decreased, and the work is carried on under more sanitary conditions when electricity is used. Tests are shown that in dough-mixing the cost of electricity is but one-tenth of the cost of the work done by hand. This cost is about as follows:

Capacity in barrels.	Time for mixing.	Cost, cents.
1¼	10 minutes	3.3
3	10 minutes	8.4
6	10 minutes	16.7

Another motor application that may be suggested to both the baker and the confectioner is in connection with ice-cream freezing. In comparing hand- with motor-driven freezers, we should realize that the result will be accomplished in much less time with the motor and the cream will be better on account of the uniform speed. The cost of production will vary slightly because to a certain extent the personal factor is introduced in packing the ice. It has been found, however, that a fair average is about three-tenths of a cent per gallon. The time required will also vary, but will probably be between 20 and 30 minutes for 40 quarts.

Butchers and grocers have taken advantage of electrically-operated meat-choppers and coffee-mills. On account of the rapidity with which these machines work they have become indispensable. Coffee may be ground at the rate of 2½ lb. per minute, and 6 lb. of meat may be chopped in the same length of time.

The electric horse-clipper and groomer is a great labor saver. By their use two horses can be clipped or groomed at once, at a cost of one cent per horse.

The general use of electric welders is rather new, but they have been found to be very satisfactory and economical machines. Alternating current is used for this work at about 22 volts. Four hundred and eighty welds per hour is the output of the machine illustrated. It would require 16 hand forges to produce the same result in this time.

In presenting these few applications it has been the intention merely to suggest possibilities that we are perhaps rather prone to overlook. Classes that may seem too small to devote much time to, but in these motor possibilities and applications that may evolve from them lie a vast field for central-station power load. If it is ever felt that we have the power situation well within our grasp and that there is little more to secure for the station, go over the territory again and canvass until every lighting customer is also a power customer and the load shown by the station curve indicates that the major part of the station is in operation at least 15 hours a day, and sufficiently well loaded to insure good economy.

Electric Refrigeration in a Meat Market.

BY R. L. LLOYD.

A very successful installation of motor-driven refrigerating machines is exhibited in the wholesale and retail meat establishment of David C. Bradley, at Dock and Water Streets, Philadelphia. The present building arrangement is the result of alterations made about a year ago to an old structure, and as planned by the architect, the following rooms would need refrigeration:

On the ground floor, one large main box or cooler, 60 ft. x 17 ft. and 12 ft. high, including the bunker space which contains the brine pipes. On the second floor, three separate rooms each 20 ft. x 20 ft. x 11 ft. to be used as freezers, the temperature in each room to be maintained at about 15 deg. Fahr.

The pickling room is located at the rear of the second floor and was to be 19 ft. x 37 ft. x 11 ft. A portion of this room is partitioned off for the brine tank, located here as the most available space, even though it was directly over what would have been the engine room. Mention is made of the engine room because originally it was the intention to use steam, and it was calculated that 40 tons of refrigeration would be required—two 20-ton machines each to be direct-connected to a 30-hp engine. A 100-hp or 150-hp boiler would be necessary, as there were pumps and elevators to run, and possibly a dynamo. It was finally decided to use central-station service and larger refrigerating machines. The following machinery was installed:

Two 25-ton Vilter refrigerating machines each driven by a 50-hp Northern motor, chain geared; one triplex, plunger, brine pump driven by a 5-hp motor; one deep-well pump for condenser water operated by a 3¾-hp motor. (See Fig. 1.)

The system employs a brine circulation exclusively, all the expansion coils being located in the brine tank. This is about

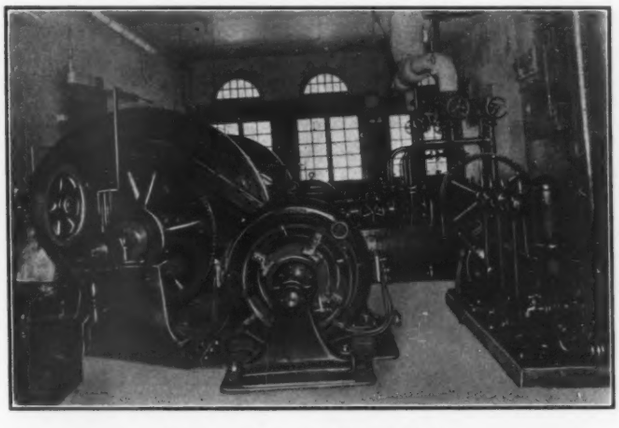


FIG. 1.—VIEW OF ENGINE ROOM.

5 ft. x 19 ft. x 8 ft. high, and contains over 5000 gallons of brine, which is cooled to a temperature of from 5 deg. to 8 deg. After being shut down over 20 hours the temperature rises to above 15 deg. There is also a 6-hp motor for the elevator on the same meter, making a total installation of 114¾ horse-power.

The object in putting in two refrigerating machines was to permit one machine to rest during heavy duty in summer and

also to allow for growth of the business. The two machines have never yet been needed at the same time. In fact, six hours' operation in 24 for one machine in the hottest summer weather so far encountered has been found ample. In winter weather one hour's operation for the machine and about one and one-half hour's operation of the brine pump is all that is required to produce the desired temperature.

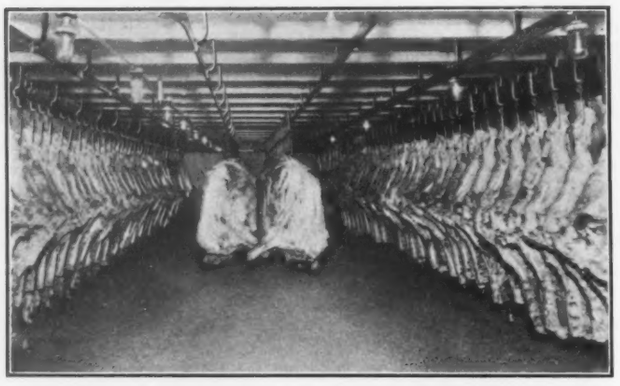


FIG. 2.—INSIDE OF THE COOLER.

The cooler usually holds about 20,000 lb. of meat and is maintained at a temperature of 35 deg. This box is well insulated with three layers of cork laid in asphalt pitch. There are three doorways to this box, and the interior is well lighted by incandescent lamps. (See Fig. 2.)

The wall cases and the counter cases in the store shown in Fig. 3 are also cooled by brine pipes. These are located above, in the wall cases and at the bottom of the counter cases. This permits of the display of choice cuts of meat without fear of deterioration.

The freezer is divided into three rooms in order to accomplish better results and to allow considerable flexibility in the accommodations. At certain seasons it is necessary to take care of more of those delicacies requiring the very low temperature and as at present arranged, one two or three sections can be utilized independently. The temperature can be maintained as low as zero in any of these rooms if necessary. A temperature of 15 deg., however, is found to be ordinarily sufficient.

The pickling room is cold enough at 35 deg., but on account

FIG. 3.—REFRIGERATED WALL AND COUNTER CASES IN STORE.

of the presence of the brine tank, the temperature is usually 30 deg. with almost no circulation in the coils of this room. The absence of excess of heat which would have been unavoidable under this room if the steam plant had been installed, results in a considerable saving in the work of refrigeration. There is frequently as much as 20,000 lb. of meat in this room.

One refrigerating machine was placed in operation about March 1 and the installation was completed a month later. Since that time there has not been the slightest delay or trouble from the equipment. It has operated on a 26 per cent load factor and the results have been entirely satisfactory. Silent chain drive is used on all the motors. The condensing water is obtained from an artesian well, the water being pumped from a 60-ft. depth by the 3¾-hp motor above mentioned.

It is rather difficult to make any comparison between the cost of operation of this equipment and the cost of ice if it had been used as of old. The freezers, of course, would not have been possible and the low temperatures of the other boxes could not have been maintained. Outside storage charges would have been incurred. Calculations indicate that not less than 150 tons of ice per month would suffice. At the prevailing prices this would have cost $375. The average bill for electric energy has been about $190, and as Mr. Bradley remarked, "Who would put in a steam plant after seeing such an outfit as this?"

Central-Stations and Electric-Motor Applications.

THE development of central-station power business during the past decade has been enormous, but the level in the power saturation curve of cities and towns of progressive growth has yet to be reached. Year after year the connected load of well-managed companies increases; annual gains of 20 to 30 per cent have not been uncommon of late; and while the recent financial stringency may have lowered the rate of new business increase at the end of 1907 and the beginning of 1908, there is no question that in a comparatively short time the best records of the past will be equaled or surpassed in the systematic acquirement of new industrial loads. As central stations grow in capacity their facilities for giving the highest character of reliable service increases, under good management; the weak spots receive closer scrutiny; experience with the rate problem points the way toward the successful handling of all classes of consumers, and the broadening usefulness of an invaluable public service encourages wider applications of power throughout the entire gamut of industrial machinery sizes and types.

To give a complete list of motor applications in keeping with the size of the commercially developed field would be impracticable, but the writer presents valuable data and figures heretofore unpublished which were carefully compiled in the interests of the principal Edison companies. They are the results of personal visits to representative plants throughout the United States and contact with both the technical and commercial aspects of the power business in a large number of cities. In applying motors of given sizes to industrial machinery it is well to constantly bear in mind that the conditions of each application should be carefully investigated in detail; that actual tests of the power needed are always preferable to assumption, and that in group-driven installations predictions of requisite motor capacities are far more difficult than in cases of individual drive. In the main, the following data give the average amount of power required for each machine mentioned, or the size of motor which would be sufficient to drive it direct-connected. As the sizes of machines decrease in group driving, the percentage of friction loss in belts and shafting tends to rise. Allowance must therefore be made by the solicitor, according to his experience, for the additional power demanded by the mechanical drive. It is out of the question to expect to reduce all industrial machine driving by motors to the direct-connected principle. As far as this can be done, it is generally advantageous, but the solicitor cannot be too industrious in the collection of actual engineering data of shafting, belt and pulley sizes and lengths in different kinds of group-operated installations. This has by no means been sufficiently considered in the past.

Certain fundamental advantages of electric power are present

in all installations. These need not be elaborated here, but may be summed up in the characteristics of compactness, of flexibility, cleanliness, safety, reliability and economy. The degrees to which these characteristics obtain in actual installations are easily discovered by intelligent analysis of working conditions.

BAKERY TRADE.

In the bakery trade compactness, cleanliness and economy are striking advantages of motors operated on central-station service. Unclean food products are commercially outlawed in these days. The modern bakery establishment handles its raw material, stock and products on a large scale, and such labor-saving devices as motor equipments should find a much wider use in the future. Representative bakery machines and their motor requirements are as follows:

	Horse-power
12-ton ice machine	03.
Apple-parer, 5 barrels per hour	1.5
Straining-cloth washer (75 shift capacity)	3.5
3 rotary ovens, capacity each, 240 pies per hour	5.
Bread-moulding machines, shapes 7000 loaves per hour	10.
Scaling machine, weighs dough 15–32-oz., 3000 pieces per hour	2.5
6-barrel dough-mixer, 18 barrels, per hour	20.
Setting-up machine, pinching rims of pies, 3000 per hour	2.
4-cake machines, mixing frosting and dough, total	10.
Sugar pulverizer, 1000 lb., per hour	10.
9-gal. ice cream-freezer, 18 minutes per batch (173 watt-hours)	0.5
Bakery machine and carpenter shop, lathe, drill, grinder, forge	10.
Squash machine, 4-bbl. brown-bread mixer, apple chopper, meat cutter, jelly press, and 4000 plate (35-minute) pie-plate washer	7.5
Flour-sifting plant, conveyors and elevators, cleaners	3.5

Refrigeration is required 168 hours per week in a large bakery to provide cold storage for eggs, milk, butter, lard and pie filling. An apple parer will core and pare a barrel of fruit in 12 minutes, doing the work of 11 men. By hand one man can pare three barrels of apples in 10 hours. In one bakery the pie-plate washer (7500 per hour) does in two hours the work of four men. At 10 cents per kw-hour a 9-gal. ice cream freezer does its work at a cost of 0.2 cent per gallon. Small dough-mixers require from 2 to 5 hp, a 10-barrel flour-mixer 10 hp, and revolving cracker-bakers, from 1 to 3 hp.

PRINTING AND PUBLISHING TRADE.

In the printing of books, pamphlets, papers and other high-grade matter dirt is fatal to success. The greasy, oily shaft and dirty belt have no legitimate place in the high-class printing establishment. Individual driving pays here as in few other places. Representative machinery is:

	Horse-power		Horse-power
Tricolor lithograph press, 1200 impressions per hour	5	Gordon job press, 10x12 in.	0.5
Single color lithograph press, 1800 impressions per hour	2.5	Golding press, 12x18 in.	0.75
Paper-cutter, 60 in.	3.5	Envelope die press	1.
Paper-cutter, 50 in.	2.	Book-paster	1.
Tube machine, 36-in. roll	0.16	Book-trimmer	3.
Wire-stitcher	0.16	Book-smasher	3.
Folding-machine, small	0.5	Book sewing-machine	1.5
Cut-out press	1.0	Book-embosser	3—10
Collator	0.5	Book-stitcher	0.25
Knife-grinder	3.5	Book paging-machine	0.12
Graining machine	1.	Book punching-machine	0.25
Ink-mill, large	7.5	One board-cutter	1.
Miehle pony press	1.	Profiling-machine	1.
Miehle No. 0 press	2.5	Gold dust machine	0.25
Miehle No. 00 press	3.	Book-stamper	2—5
Miehle No. 000 press	4.	Ruling-machine	0.25
Miehle No. 0000 press	5.	Round-cornering rack	0.5
Whitlock press, 25x38 in.	2.	Book-gumming rack	0.12
Cottrell press, 25x30 in.	1.5	Prouty perfecting press, 12x18 in.	1.0
Cottrell press, 38x52 in.	3.0	Linotype machine	0.25
Cottrell press, 42x56 in.	5.0	Type-casting machine	0.5
Cottrell press, 43x60 in.	5.0	Paper-baster	2.0
Cottrell press, 46x60 in.	5.0	Knife-grinder (small)	2.0
Cottrell perfecting press 39x54 in.	7.5	Oswego cutter, 44 in.	2.0
Campbell press, 35x47 in.	4.0	Oswego cutter, 36 in.	1.0
Campbell pony press	2.	Sanborn cutter, 48 in.	2.0
Century press, 32x52 in.	4.	Sheridan cutter, 24 in.	0.25
Century press, 22x32 in.	1.5	Seybold embosser	5.
Scott press, 22x32 in.	1.5	Cardboard-splitter	1.
Scott press, 33x47 in.	5.	Envelope-machine	1.
Scott press, 42x55 in.	5.	Seybold 3-knife book-cutter	5.
Scott press, 26x34 in.	2.	Victory embossing-machine	1.
Cranston press, 17x22 in.	1.5	Ink-mills	1—7.5
Campbell press, 21x30 in.	1.5	Blackball embossing-machine	0.5
Century press, 42x60 in.	7.5	Monotype-machine and air-pump	2.
Century press, 28x42 in.	4.	Folding-machine, 36x49 in.	1.
Century pony press	2.	Folding-machine, 40x56 in.	2.
Huber press, 42 in.	2.5	Brown folder, 48 in.	2.
Huber press, 52 in.	5.	Case-roller	0.25
Huber press, 63 in.	7.5	Envelope-folder	0.7
Colts Armory press, 12x19 in	1.0	Glue-mixer	1.0
Colts Armory press, 10x12 in.	0.5		

LAUNDRY TRADE.

Until within a year or two, electric motors have not been much used in the operation of laundry machinery, but the success which has attained the pioneer installations shows that here is a remarkable field for the central station. As before stated, when machinery grows lighter the percentage of power lost in belt- and shaft-drives increases in relation to the amount of power utilized and generated. Laundry machinery requires small powered motors for direct driving, and the extensive application of direct connection between the motor and the machine is peculiarly desirable under laundry operating conditions. In some steam laundries 50 per cent of the power generated, or

MOTOR EQUIPMENT OF LAUNDRIES.

5 extractors and 4 starch 18-in. extractors, 1 hp motor each, vertical shaft direct drive, series type, speed 1150—1600 r.p.m.
4 washers, 5 ft. long, 4 ft. diameter; 2 shakers, 50-in.x60 in.; 10-hp compound constant speed, belted, motor 650 r.p.m.
2–48-in. vertical wringers, each belt driven by 5 h.p. compound motor, 1310 r.p.m.
1 shaker, 4 washing machines—10-hp motor; 2 groups.
1 shaker, 5 washing-machines—10-hp motor.
4 steam mangles, each 48-in. diameter, 105 in. long, each direct-driven, 3 hp motor, series-wound; speed range, 350–550 r.p.m.
1 freight elevator—15-hp motor.
2 No. 55 Singer sewing-machines, each direct-driven by 0.12 hp shunt motor, speed, 1050 r.p.m.
1 blanket-washer (Hunter), 6 small blanket-washers, 42x60 in.—10-hp compound, group driven motor.
1 collar-washer, 40x42 in.; 5 washers, 42x60 in.—10-h.p. group driven motor.
1 collar dampener—0.5 hp, shunt wound motor.
1 Bishop collar-starcher, 42x14 in.—0.25-hp shunt motor, 1000 r.p.m.
8-loop shirt dry-house—2 fans, conveyor belt 2 rev. per hour, 3-hp shunt motor, 750–900 r.p.m.
Skirt dry-house—0.12-hp fan motor for hot air circulation.
4-loop Barnes & Erb collar dryer—3 rev. of belt per hour, 1 fan, 1-hp shunt motor 600–850 r.p.m.
Coat and underwear dryhouse fan—0.12 hp motor, (size uncertain).
1–24-in. coat-ironer—0.25-hp compound motor; 500–600 r.p.m.
4–24-in. coat-ironers—0.5-hp compound, constant-speed motor; 420 r.p.m.
2–36-in. body-ironers—0.5-hp compound, constant-speed motor; 420 r.p.m.
2 sleeve-ironers—12-in. cylinders; 0.12-hp shunt motors; 500 r.p.m.; frequently reverses 60 times per minute; no starting-box.
3 bosom pressers—1 hp shunt motors; 610 r.p.m.
1 bosom ironer—0.25-hp shunt motor; 450 r.p.m.
1 Bishop wristband ironer—0.12-hp shunt motor, 1000 r.p.m.
1–40-in. Hazen collar mangle—0.5-hp shunt motor, 450 r.p.m.
1 collar shaper, 1 seam dampener, 1 burnisher—group driven on 1-hp, back geared shunt motor; 1830 r.p.m.
1–6 ft. handkerchief mangle—0.5-hp shunt motor; 450 r.p.m.
Drill press, lathe, hand saw, and grinder; 10-hp group driven compound motor.

100 per cent of the power utilized, is lost in belt and shaft transmission. The different departments of a modern laundry do not all operate at full load at the same time, and the flexibility of the electric drive has proved of great value. The shut-down of one motor-operated department does not affect the others, and the line losses do not continue consuming coal. Where the electric drive is employed, with individual motors, speed regulation becomes easy; the speed can readily be adjusted to the quality of material in the machine, which is often not the case

MOTOR EQUIPMENT OF WOODWORKING ESTABLISHMENTS.

	Horse-power		Horse-power
6-in. moulding machine	3—5	15-in. rip-saw	5.
7-in. moulding machine	5—7.5	20-in. rip-saw	10.
8-in. moulding machine	7.5—10	30-in. rip-saw	20.
9-in. moulding machine	10—15	48-in. rip-saw	35.
8-in. crosscut saw	1.	Jig saw, small	1.
10-in. crosscut saw	2.	Shingle machine	10.
12-in. crosscut saw	3.	Shingle saw	1.
16-in. crosscut saw	5.	Wood-carver	2.
20-in. crosscut saw	7.5	Box-nailer	1.
24-in. crosscut saw	10.	Saw-set	1.
30-in. crosscut saw	15.	8-in. buzz planer	1—1.5
Small band saw	1.	12-in. buzz planer	1.5—2
Medium band saw, 1 in.	2.	16-in. buzz planer	2—3
2-in. band saw	5.	24-in. buzz planer	3—4
Tenoning and mortising machine	3.	30-in. buzz planer	4—5
Saw-grinder	1.	Inside moulder	7.5—10
Wood lathe	1—5	Outside moulder	5.—7.5
Wood boring-machine	1.	Horizontal edger	2.
Double spindle shaper, 1¼ in.	7.5	Large nailer	1.5
Sticker, 9 in.	7.5	Double and single planers	7.5—15
Power-mortiser	2—4	30-in. sanders	3—5
Panel-raiser	1—3	42-in. sanders	5—7.5
Surface-sander	1—2	60-in. sanders	10.
Box-dresser	1.	72-in. sanders	15.
Planer and matcher	6—10	Dado machines	1—2
Planer, 24-in.	15.	Dowel machines	0.5—0.75
Planer, 36-in.	25.	Box nailer, medium	0.75
Box-board matcher	2—3	Box dovetailer, large	10.
Single-surface planer	3.5—7.5	Box dovetailer, small	25.
Double-surface planer	7.5—15.	Dovetailers	2—3
Tenoner, double end	7.5—.15	Mitre machine	1—2
Tenoner, single end	2—5	Bit-mortiser	1—2
8 in. rip-saw	1.	Sash-mortiser	1—2
10-in. rip-saw	3.	Hollow chisel mortiser	2—3

in a steam-driven laundry. Cleanliness and increased comfort to employees are additional points of particular weight during hot-weather periods. A field also exists for the replacement of gas-heated flat-irons by electric irons in laundry service.

The classified equipment of a representative 220-volt, direct-current plant now in operation is given above.

WOODWORKING ESTABLISHMENTS.

The supply of electric power to woodworking establishments is desirable mainly on the ground of the comparatively large motors required in handling wood stock, the decrease of fire hazard, decreased obstruction of motors and wires, and better economy of electricity compared with the non-condensing steam engine with atmospheric exhaust. No licensed engineer is necessary with electrical installation. Even in small woodyards, central-station current is making enviable records in power economy, while in large plants, all the advantages of a careful design of installation are attainable among the tools susceptible to motor drive. A list of these is given on the previous page.

MACHINE SHOPS.

Although some of the earliest examples and most modern instances of the motor drive are found in the machine shop, there remain a vast number of such establishments to be placed on central-station circuits. In the machine shop conditions tend to change and require the relocation of tools from time to time; expansion is often a pressing problem, and intensified production is essential to commercial success. Regardless of its operating efficiency, the electric motor is the ideal flexible power for general machine service. The range of metal-working tools that have received the careful study of motor designers is of immense breadth, yet there are to-day central stations operating in large manufacturing centers which are not doing 15 to 20 per cent of the business which ought to be theirs. A power connected load of only 2000 horse-power or 3000 horse-power in a manufacturing town of over 100,000 people, and with coal at $4 to $5 per ton, simply represents undeveloped opportunities. The following is a list of typical metal-working tools:

	Horse-power		Horse-power
Engine lathes, 22 in.	2.	Driving-wheel lathe, 66-in. swing	10.
Engine lathes, 30 in.	2.5	Driving-wheel lathe, 90-in. swing	15.
Engine lathes, 42 in.	3.5	Slab milling-machine, 26-in.	8.
Engine lathes, 54 in.	5.	Slab milling-machine, 36-in.	12.
Engine lathes, 60 in.	6.	Slab milling-machine, 48-in.	15.
Engine lathes, 72 in.	8.	Emery wheels	0.5—10
Engine lathes, 84 in.	10.	Key-seating machine	2.
Planers, single, 26-in.	5.	Cut-off saw	0.25
Planers, double, 30–36 in.	9.	Speed-lathe	0.5
Planers, double, 38–40 in.	12.	Tool-lathe	1.
Planers, double, 44–48 in.	14.	12-spindle drill	10.
Planers, double, 54 in.	15.	Boring machine, 48-in. horizontal	2.5
Planers, double, 60 in.	18.	Boring machine, 66-in. horizontal	4.
Planers, double, 72 in.	22.	Boring machine, 72-in. horizontal	5—7.5
Planers, double, 76 in.	25.	Drill press, 24 in.	1.5
Planers, double, 84 in.	30.	Drill press, 40 in.	3.
Planers, double, 120 in.	40.	Drill press, 60 in.	5.
Planers, double, 144 in.	50.	Radial drills	2—5
Boring mill, 36-in. swing	4.	Automatic screw machine	1.
Boring mill, 51-in. swing	5.	Fox lathes	1—3
Boring mill, 60-in. swing	6.5	Turret lathes	1—3
Boring mill, 72-in. swing	7.5	Pipe cutter, 0.5 in.	0.5
Boring mill, 84-in. swing	10.	Pipe cutter, 2.0 in.	1.
Boring mill, 120-in. swing	12.	Pipe cutter, 4. in.	2.
Boring mill, 192-in. swing	15.	Pipe cutter, 8 in.	3.
Shaper, 16-in. stroke	3.	Pipe cutter, 12 in.	5.
Shaper, 18-in. stroke	3.5	Pipe cutter, 24 in.	10.
Shaper, 24-in. stroke	5.	Double buffer and polisher	3—10
Shaper, 30-in. stroke	6.	Bolt cutter	1—3
Crank slatter, 10-in. stroke	4.	Rod straightener	5.
Crank slatter, 14-in. stroke	5.		
Crank slatter, 18-in. stroke	6.		
Crank slatter, 30-in. stroke	7.5		
Forge slotter, 24-in. stroke	10.		
Forge slotter, 40-in. stroke	13.		
Forge slotter, 60-in. stroke	15.		

CANDY MAKING.

Motors of small size are required in the manufacture of confectionery, but in a large factory of this character the total load is well worth securing. Cleanliness and economy in labor are two important points in this branch of motor application.

	Horse-power		Horse-power
Marshmallow kettle	1.	Candy-rocker	0.75
Starch buck	1.	Corn-sheller	0.5
Starch-cleaner	0.5	Sugar-grinder	5.
Jap kettle	1.	Sugar-bolter	2.
Nougat-mixer	1.	Mixing-kettle	2.
Peanut roaster	0.25	Chocolate-dipper	1.
Peanut-husker	0.5	Cream-grinder	5.
Cocoa bean roaster	3.	Cream-stirrer	2.
Almond-crusher	0.5	Depositor	0.5
Caramel-sizer	3.	Printer	0.5
Lozenge-mixer	2.	No. 3 Lehman chocolate melanger	5.
Lozenge-roller	1.	Small chocolate melanger	3.
Dough-baker	2.	Chocolate mixing kettle	1.
Candy-puller	0.5—5	Chocolate mixer, Walters	0.5
Candy-polisher	1.5	Chocolate roaster, Holmes	0.5
Candy-roller	1.	Chocolate shaking table	0.5
Candy-mixer	3.	Chocolate rolling machine	5.
Sugar-pulverizer	15.	Chocolate dipper, Walters	0.5
Sugar-mixer	5.		

COOPERING.

	Horse-power		Horse-power
Large hoofing machine	5.	Heading machine	2.
Stave planer	4.	Barrel planer	2.
Crushing machine	5.	Stave bending machine	1.

ELECTROTYPING AND STEREOTYPING.

	Horse-power		Horse-power
Boyle router	1.	Trimmer	0.5
Wesel Daniel planer	2.	Saw	0.5
Rougher	2.	Small planer	0.5
Drilling and jig saw	0.5	Agitator	0.5
Beveler and grinder	1.	Bender	3.
Zinc etching rocker	1.	Flat shaver	.3
Black leader	0.5	Wax shaver	0.5
Moulding press	4.	Etching machine	3.
Plate reducer	2.	Etching tubs	0.5
Automatic plate machine	10.	Trimmer	3.
Scorcher	0.5	Double page shaver	3.
Double page tail cutter	5.	Matrix roller	2.

BUTCHER SHOPS.

	Horse-power		Horse-power
Large meat chopper, 6-knife	15.	No. 3 Boss mixer	7.5
Lard cooler	3.	Spice mill	2.
No. 66 Enterprise meat grinder	10.	9-knife meat rocker	2.
		Lard press	5.

COTTON MACHINES.

	Horse-power		Horse-power
Braker cotton picker	10.	Cotton masher	7.5
Cotton carding machine	20.	Cotton tumbling barrel	2.
Finished picker	15.	Cutton dryer	20.
Small carder	2.		

Looms and spinning frames require special treatment, usually group driven.

JEWELERS.

	Horse-power		Horse-power
Polishing lathe	2.	Other lathes	0.16—2.0
Polishing stone	1.		

GROCERIES AND SPICE MILLS.

	Horse-power		Horse-power
Coffee grinders	0.5—3.	Large sugar pulverizer	15.
Enterprise meat grinder	0.5—3.	Baking powder mixer	1.
Coffee roaster	2.	Crystal grinder	2.
Coffee polisher	2.	Flour mixer	3—10
Spice mills	3—15	Flour packer	20.
Green coffee mixer, 30 bag	25	Filling machine	0.5
Bag stitcher	1		

FOUNDRIES.

The ability of the electric motor to withstand abuse and dirt and its freedom from shafting ills are some of the chief advantages of its use in foundries. The electric crane is an absolute necessity in the modern large foundry, and it often is the limiting factor in the speed of production. Some motor uses:

	Horse-power	
Casting rattlers	1—10	
Casting grinders	3—5	
Root blower, No. 1	5.	
Root blower, No. 2	6.	
Root blower, No. 1 cupola	7.	capacity, 1.5 tons per hour
Root blower, No. 2 cupola	10.	capacity, 2.5 tons per hour
Root blower, No. 3 cupola	15.	capacity, 3.5 tons per hour
Root blower, No. 4 cupola	20.	capacity, 5.5 tons per hour
Root blower, No. 5 cupola	35.	capacity, 9 tons per hour
Root blower, No. 6 cupola	45.	capacity, 13 tons per hour
Root blower, No. 7 cupola	60.	capacity, 18 tons per hour
Root blower, No. 8 cupola	80.	capacity, 24 tons per hour
Root blower, No. 9 cupola	100.	capacity, 35 tons per hour

FEATHER MACHINES.

	Horse-power		Horse-power
Renovators	1—7.5	Feather pickers	1—3
Crusher, single	10.	Mattress tufter	2.
Crusher, double	20.	Cotton picker	1—5

ICE-CREAM MACHINERY.

	Horse-power		Horse-power
6-gal. freezer	1.	25-gal. freezer	5.
9-gal. freezer	2.	Ice crusher	1.
15-gal. freezer	3.	Cream separator	5.
Bottle washer	1.		

MACARONI MACHINERY.

	Horse-power		Horse-power
Dough mixer	2.	Screw press	2.
Cut-off machine	0.25		

PAINT MACHINERY.

	Horse-power		Horse-power
Paint grinders	3—15	Packer	7.5
Screen and conveyor	5.	Lead pulverizer	2—10
Water mill lead grinding	35.	Mixing tanks	3.
Oil mill lead grinding	20.	Lead roll	10.
Shaker mixer	3.	Buckle machine	5.
Putty cleaner	10.	Mineral paint grinder	20.

PAPER-BOX MACHINERY.

	Horse-power		Horse-power
Scoring machine	1.	Downing machine	0.5
Corner cutter	0.12	Slitting machine	0.5
Strawboard slitter	1.	Wire stitcher	0.12
Nailing machine	0.25	Wrapping machine	0.25
Cornering machine	0.1	Crimping machine	0.33
Corner stayer	0.12	Tin press	0.66
Tube roller	0.25	Swedging machine	0.25
Spiral box machine	1.	Covering machine	0.25
Baling press	5.	Dextrine mixer	2.
Liner and dyer	2.		

REFRIGERATING MACHINERY.

Capacity	Horse-power	Capacity	Horse-power
1 ton, 24 hours	2.	7 tons, 24 hours	10.
2 tons, 24 hours	3.5	8 tons, 24 hours	12.
3 tons, 24 hours	5.	9 tons, 24 hours	13.5
4 tons, 24 hours	6.	10 tons, 24 hours	15.
5 tons, 24 hours	7.5	11 tons, 24 hours	25.
6 tons, 24 hours	9.		

This class of machinery offers unusual advantages in the con-

sumption of non-peak power. Its demand is least during the season of heaviest lighting output.

SHOE FACTORIES.

These establishments are steadily being won over to the motor drive, although the group method is practically standard so far. In the manufacture of a pair of shoes by the best modern methods, over 50 distinct operations are required. The number of shoe machines in service to-day is extremely varied. Few require 3 horse-power or over, each. Among the 3-hp machines are the Mayo heeling machine, and the stitching machine. Machines requiring 2 horse-power are also few, including the McKay heel trimmer, Adams sole cutter, leveler, 4-ft. leather knife and 4-ft. die press. Under 2 horse-power, but not less than 1 horse-power, are edge setters, Buzzell head shaver, Buzzell trimmer, Union twin-edge setter and sole laying machine. The great majority of other shoe machines range from 0.2 horse-power to 0.5 horse-power each, though some run as low as 0.06 horse-power.

STRUCTURAL STEEL AND BOILER WORKS.

	Horse-power		Horse-power
Punch, ¼" hole in ¼" steel	1.	Shear, ¼" steel	1—3
Punch, ½" hole in ½" steel	3.	Shear, ½" steel	7.5
Punch, ¾" hole in ¼" steel	5.	Shear, 1" steel	10.
Punch, 1" hole in 1" steel	7.5	Shear, 12" horizontal	20.
Coping machine, 24-in. I-beam	7.5	Bull dozers	5—15
Beam shear	20.	Rotary column planer, 48 in	10.
Plate bending rolls according to size	3—50	Cleveland straighteners	5—15
3x3 angle shear	5.	40-in. beam saw, cold 24-in. I	75.
8x8 angle shear	10.	Cold saw, slow speed	5.
12-ft. gate shear	30.	Universal punch	10.
Bolt machine	5.	Rivet machine	5.

Cranes of all sizes are included in this class of service.

The foregoing applications represent, as has been said, but a small fraction of the total uses now made of electric motors. Outside the manufacturing field are hospitals, hotels, markets, churches (operation of partition screens, fans, organs), dental offices, business offices (a large number of small motors are now driving labor-saving appliances like addressographs, letter copiers, calculators, etc.), chemical laboratories (fans, stirrers, grinders), households—in short, every place where work is done by other than straight manual labor. In securing data upon its power business the central station has a wonderful opportunity to accelerate its acquirement of new and profitable connected load.

Power Requirements of Machine Tools.

We have published from time to time data on the power requirements of various machine tools operating under various conditions of load, feed, etc., and when operating on different metals or different grades of the same metal. Such data are of value in equipping existing machine tools with electric motors for individual or group drive; and being only ascertainable by test, data for every tool working under any and every condition of service are by no means complete. In the Dec. 1, 1906, number the motor-driven, machine-tool equipment of the Hornell shops of the Erie Railroad Company was described and Mr. L. R. Pomeroy contributes to a recent number of *General Electric Review* additional information on the power requirements of railroad shop tools.

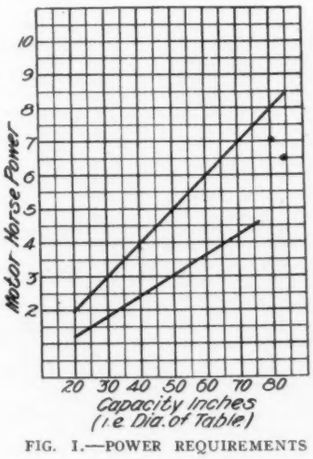


FIG. 1.—POWER REQUIREMENTS OF DRILL PRESS.

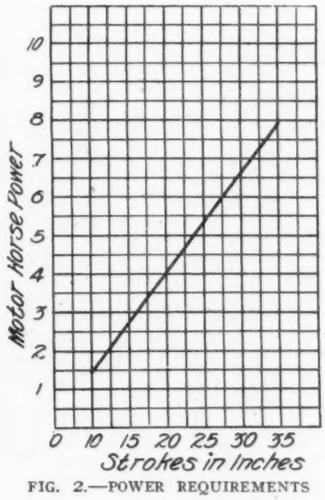


FIG. 2.—POWER REQUIREMENTS OF SHAPER.

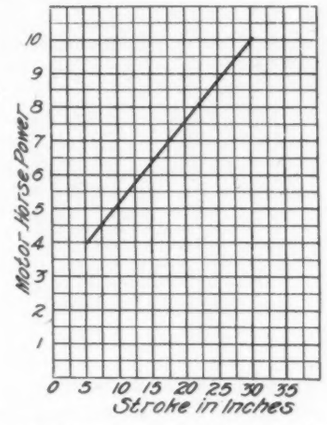


FIG. 3.—POWER REQUIREMENTS OF SLOTTER.

The curves shown in Figs. 1 to 8, together with the accompanying table, cover the horse-power requirements of the machine tools generally found in railroad repair shops. Where tools are selected for the purpose of performing extra heavy service to utilize the full capacity of the new, rapid-cutting tool steel, as is now done in manufacturing shops, the power required to drive the machine must be calculated on the basis of service required. Such cases are, however, exceptional and the curves will be found to meet the majority of conditions. The following formula may be used for calculating the power requirements of tools operating with the rapid-cutting tool steel:

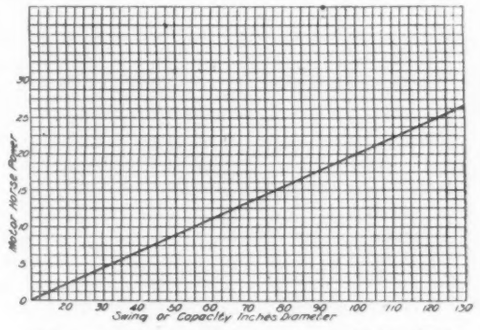


FIG. 4.—POWER REQUIREMENTS OF BORING MILL.

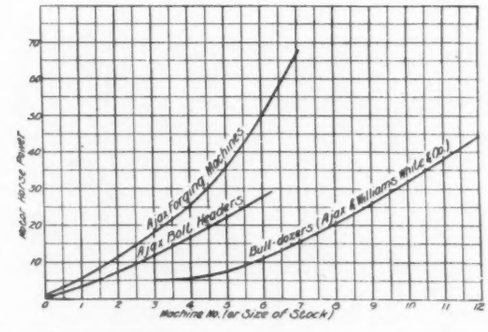

Motor Horse Power
10 20 30 40 50 60 70
Ajax Forging Machines
Ajax Bolt Headers
Bull-dozers (Ajax & Williams make)
0 1 2 3 4 5 6 7 8 9 10 11 12
Machine No. for Size of Stock

FIG. 5.—POWER REQUIREMENTS OF FORGING AND BOLT HEADING MACHINES.

$$HP \text{ to drive} = F \times D = f.p.m. \times 12 \times N \times K$$

where F is the feed in inches; D the depth of cut in inches; f.p.m. the feet per minute; N the number of tools cutting, and K a constant which for cast iron varies from 0.35 to 0.5; for

soft steel or wrought iron, 0.45 to 0.7; for locomotive driving wheel tires, 0.7 to 1; and for very hard steel, 1 to 1.1.

For calculating the power required for wood-working tools

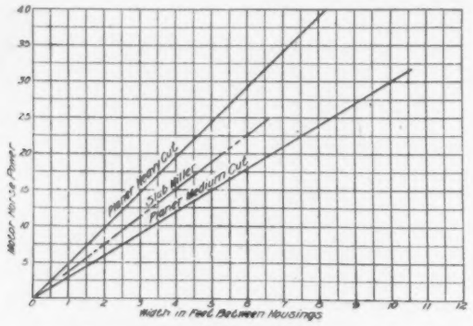


FIG. 6.—POWER REQUIREMENTS OF PLANERS.

the following formula may be used; the formula providing for the thickness of the belt and the allowance for centrifugal force and for the arc of contact being less than 180 deg. is taken care of in the selection of values for the constant K:

$$HP = t \times w \times f.p.m. \times K$$

or if r.p.m and not f.p.m. is known

$$HP = (t \times w \times d \times r.p.m. \times K) \div 4$$

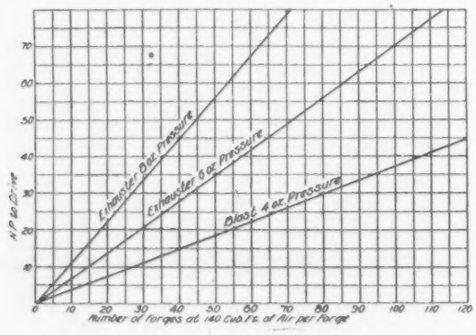

H.P. to Drive
Number of Forges at 140 Cub. Ft. of Air per Forge
Exhauster 8 oz. Pressure
Exhauster 6 oz. Pressure
Blast 4 oz. Pressure

FIG. 7.—POWER REQUIREMENTS OF FANS.

where t is the thickness of the belt in inches; w the width of the belt in inches; d the diameter of the pulley in inches and K a constant which for a leather belt varies from 0.0062 to 0.0098; for a cotton belt, 0.0036 to 0.0068 and for a rubber belt 0.005 to 0.0082.

Tool builders do not always discriminate between the requirements of manufacturing plants and those of railroad repair shops, and for that reason motors are often recommended that are larger than necessary. For instance, a lathe having a capacity of two cuts, each 5/8 in. by 1/8 in. at 60 feet per minute at this rate of cutting will require a 60-hp motor. Another machine built for the same class of work and used largely in axle shops and in many railroad shops is capable of taking cuts of 3/4 in. by 1/12 in. at 24 feet per minute, requires 18 horse-power and is usually equipped with a 20-hp motor. While this power is correct for the full capacity of the machine, 10 horse-power will cover the requirements of the same tool on average railroad work.

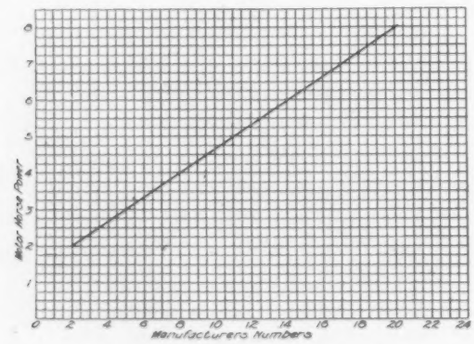


FIG. 8.—POWER REQUIREMENTS OF PIPE THREADING AND CUTTING MACHINES.

BOLT AND NUT MACHINERY, HELVE HAMMERS, MULTIPLE DRILLS, ETC.

	Motor hp required to drive
1½" single head bolt cutter	1½
Pratt & Whitney No. 4 turret bolt cutter	2
2 spindle stay bolt cutter	2
1½" Acme double head bolt cutter	2½
1½-2½ Acme nut facer	2½
6 spindle nut tapper	3
1½" triple head bolt cutter	3
¾-2¼" double head bolt cutter	3
2" triple head bolt cutter	5
4 spindle stay bolt cutter	5
Bradley hammer	7½
Niles 4 spindle multiple drill	7½

GRINDERS.

Air cock grinder	1
No. 3 Brown & Sharp universal grinder	3
Link grinder	3
Sellers universal grinder for tools	5
Norton 18" x 96" piston-rod grinder	5

MILLERS.

Vertical miller Becker Brainard No. 2	1
Valve miller No. 2	2
Universal miller No. 3 Brown & Sharp	2
Universal miller No. 4 Brown & Sharp	3
Universal No. 6 Becker Brainard	5
Niles heavy vertical	10

PUNCHES AND SHEARS.

No. 4 36" throat L. & A. punch	3
No. 9 horizontal flange punch	5
No. 2 Hillis & Jones combination punch and shear	5
Alligator shear (stock 5" x 1")	5
Lenox rotary bevel shear	7½
56" multiple tank plate punch with spacing table	7½
No. 3 Hillis & Jones combination punch and shear, 12" throat	7½
No. 2 horizontal punch 20" throat	7½
No. 3 Hillis & Jones combination punch and shear, 36" throat	10
No. 3 angle shear 5" x 1" bar	10

SAWS.

	Motor hp required to drive
Band saw, 36" wheel	3
Band saw, 42" wheel	5
Swing cut off saw	5
Band saw, 48" wheel	7½
Greenlee 1½ self-feed rip saw	10
Greenlee vertical aut. cut-off saw	15
40"-46" saws	15
Auto. band resaw	20
Greenlee No. 6 aut. cut-off saw	20
Greenlee No. 3 rip saw	20
Woods No. 4 rip saw	20
Ex. heavy aut. rip saw	25

WOODWORKING TOOLS.

Fay-Egan single spindle vertical boring machine	3
Fay-Egan 3 spindle vertical boring machine	4
Fay-Egan No. 6 vertical mortiser and borer	6
Fay-Egan No. 7 tenoner or gainer	7½
Fay-Egan universal wood worker	7½
Fay-Egan 4 spindle vertical borer	7½
Fay-Egan 5 spindle vertical borer	10
14" inside moulder	12
Fay-Egan universal tenoner and gainer	12
Fay-Egan vertical tenoner	12
Greenlee aut. vertical tenoner	15
Fay-Egan No. 3 gainer, also Greenlee	15½
Greenlee Ex. Range 5 spindle borer and mortiser	15
Greenlee vertical mortiser	15
Fay-Egan Auto. gainer, also comb. gainer and mortiser	20
Fay-Egan No. 8 vertical saw and gainer	20½
Vertical hollow chisel mortiser and borer	20
Fay-Egan 14½" double cyl. surfacer	20½
Heavy outside moulder	20
6 roll D. C. planer and matcher	25
Double cylinder fast flooring machine	30
Double cylinder planer and matcher	30
Fay-Egan No. 8 auto. tenoner	30½
Woods No. 27 matcher	35
4 side timber planer, heavy	60

Lamp Tests in a Large Industrial Plant.

A large industrial and mining corporation which buys large quantities of incandescent lamps and wishes to test them under the operating conditions of vibration, voltage variation, etc., which occur on its property, pursues the following method in testing and purchasing incandescent lamps. Before a contract is placed, 1000 lamps are purchased in the open market of the various makes which are to be considered in competition for the

contract. These 1000 lamps have samples tested for life and efficiency. After the contract has been placed with any given lamp factory, two out of every 250 lamps received are taken out for testing to determine whether they are up to specifications. One of these is ordinarily put through the test for life and efficiency. The other is kept on file for reference in case of accidental breakage of the first lamp. A variation in candle-power of 7 per cent from the rated is allowed on new lamps. The life and efficiency tests are made in the ordinary way. As a further check to life tests, however, it is customary to install watt-meters on certain lighting circuits around the plant and to fill these circuits with new lamps of the kind to be tested. These circuits have all their lamps burning continuously, the lamps never being turned off. By keeping track of the kw-hours supplied to these circuits and of the lamp renewals, a check on laboratory life tests is obtained which gives an idea of how lamps are wearing in actual commercial work.

A New Field for Electric Power.

By GEORGE H. JONES.

There are thousands of buildings, especially apartment buildings, in Chicago, and presumably in other large cities, where electric motors can be used to great advantage in connection with the steam-heating system. In most of these apartment buildings a low-pressure heating system is installed, the condensed water being returned to the boiler by means of gravity. When first installed these systems were operated at approximately 3-lb. boiler pressure. The average apartment building is put up in a very cheap manner with insufficient supports, the result being that in a very short time the building settles greatly in parts, and the effect is further aggravated by the fact that the foundations are often laid in the winter time when the frost is in the ground. This settling of the building does serious damage to the heating system. The return pipes, which were originally installed so as to give a sufficient slant for the return to the boiler of the condensed steam, are disarranged, the result being that pockets are formed in which the condensed steam settles. In order to force this water back to the boiler and heat the building properly, the boiler pressure has to be raised to from 8 lb. to 12 lb.

This difficulty may be entirely overcome by the use of a pump to draw the water of condensation back to the boiler. As steam pumps cannot be used satisfactorily at such low pressures, the field is open entirely to the electric motor. The cost of the electric pump, together with the piping, automatic starting device, etc., is comparatively small, being approximately $225. The saving in coal bills resulting from the use of this apparatus is apparent, as the reduction in pressure of each pound effects a saving of about 3 per cent on the coal bills. In addition to this saving, the motor equipment does away with the pounding in the pipes, and, furthermore, the heating system can be gotten into service in a very much shorter time than with the old arrangement.

Some installations are met with in which steam pumps are now used, these pumps exhausting into the atmosphere. Here the substitution of an electrically driven pump will also result in a great saving, as the inefficiency of small steam pumps is well known. I have in mind one case of a steam plant, operating at low pressure, supplying 24 apartments, where a steam pump was used, and it was necessary to maintain 7 lb. boiler pressure to run the pump. This pump was replaced by an electric one, and the boiler pressure reduced to 3 lb., with the result that the saving in the coal bills was something like $60 per month, whereas the cost of operating the motor was only $1.90 per month.

Although the current consumption of these motors is small, yet when we consider the thousands of installations which can be made, the aggregate amount of current that may be used should make the business well worth going after from the central-station manager's point of view, especially as steam heating may extend over eight months of the year.

Electric Elevator Service.

By R. S. HALE AND R. H. GRAY.

It is well known that the consumption of electricity by electric elevators varies considerably with the kind of service. The ordinary builders' tests show the variation due to load, speed, counterweighting, etc. In addition, a motor is naturally less efficient at the moment of starting than it is after it comes to speed, so that a run from the bottom to the top of a building, requiring a stop at each floor, will take considerably more electricity than a straight run without stops.

Recently a particular electric elevator showed up rather badly in consumption and the manufacturers claimed that the elevator service in the particular building was unusually severe, involving very frequent stops, which accounted for the high energy consumption.

Knowing of no data on elevator service in different buildings the writers made an investigation with the following very interesting results:

The elevators in a large, first-class hotel showed an average of 3.57 floors per stop. One floor per stop means stopping at every floor and 10 floors per stop in a 10-story building would mean running from the top to the bottom without intermediate stops.

In a large apartment house consisting of non-housekeeping suites of from one to five rooms each the elevator averaged 2.91 floors per stop.

The elevators of a large office building averaged 4.11 floors per stop from 8:30 to 9:30 when people were coming to their offices. From 3:30 to 4:30 the elevators in this same building averaged 2.06 floors per stop. This building has a dozen elevators and no very large companies as tenants.

In another office building with only two elevators the average was 4.19 floors per stop from 8:30 to 9:30 a. m. and 4.42 floors per stop from 3:30 to 4:30 p. m. This building is occupied by a single concern whose work involves frequent trips by employees to and from intermediate floors, while in an ordinary office building any particular passenger travels only from the first to his own floor.

In a large department store with large elevators the average was 1.41 floors per stop.

The hotel and apartment house elevators were operated on the basis of making only the necessary runs; that is, if a passenger wanted to go to the fifth floor, the elevator stopped at the fifth floor and then returned. The elevators in the two office buildings and the department store were operated on the basis of complete trips; that is, if an elevator started it went to the top floor and then back again even if no passengers were carried. This, of course, would naturally make a considerable difference in the number of floors per stop and probably accounts for the large number of floors per stop in the office building with only two elevators.

Blow-Off Valves for Steam Boilers.

By R. T. STROHM.

It seems to be an undisputed fact that the blow-off valve is a troublesome though necessary adjunct of the steam boiler. At more or less regular intervals it is opened for the discharge of steam, hot water and such sediment or scale as may have been carried into or formed within the boiler during the evaporation of the water. In this respect, the service that it is called upon to perform is particularly severe. To secure a tight valve for cold or hot water pressure or for steam is not a difficult matter. But when a valve is called upon to pass both solid and fluid matter and also to undergo considerable changes of temperature, it is not surprising that trouble should be experienced in keeping it tight and preventing leakage.

The desirable qualities of a blow-off valve are tightness, durability, simplicity of construction and operation, ease of

repair and fair cost. Of these, the first must be classed as the most important, since the danger of using a valve that may unexpectedly allow the water to drain out of a boiler must be obvious. The blow-off from a boiler should always be arranged so that the engineer or attendant can inspect the discharge end of the pipe at any time to determine whether or not there is any leakage.

This leakage may be due to one or more of several causes. When the blow-off valve is opened, the scale and sludge that

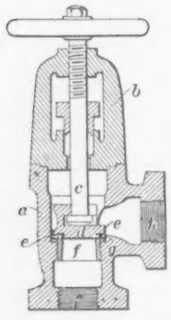


FIG. 1.—PLAIN ANGLE BLOW-OFF VALVE.

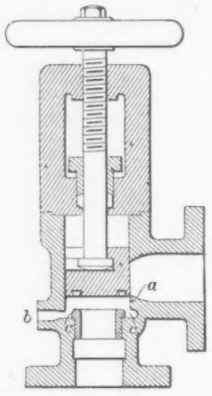


FIG. 2.—ANGLE VALVE WITH STEAM BLAST CONNECTION.

have accumulated near the end of the blow-off pipe are discharged past the valve seat with considerable velocity, thereby producing an erosive effect upon the seat that may sooner or later form grooves, permitting the escape of water even when the valve is supposed to be closed. If such action continues unchecked, the valve seat is cut deeper and conditions grow worse very rapidly.

Again, particles of very hard scale may be caught between the valve seat and the plug or disc when the valve is being closed. If the disc is then forced down until there is no further passage of water, the seat or the face of the disc will be scored by the crushed scale. At the next opening of the valve, the scale will be swept away, and the indentations remaining will allow of leakage when the valve is closed again. As a consequence, the blow-off valve should be so constructed as to permit repairs to be made easily and quickly.

In Fig. 1 is shown an ordinary type of angle blow-off valve. The body *a* and the yoke *b* are of iron and are held together by bolts not shown in the illustration. The valve stem *c* is threaded where it passes through the yoke, and at its lower end carries the disc *d*. The disc is not rigidly attached to the stem, but is slotted so as to slip easily over the bolt-head at the lower end of the stem. By this construction it is possible to remove the disc very quickly, after the yoke is loosened and both stem and disc lifted out.

The under surface of the disc *d* contains a circular groove *e* of dovetail section, into which Babbitt metal is poured and hammered and afterward faced off smooth. The valve seat *f* consists of a hard brass ring screwed firmly into the valve body. This ring is rounded along its upper edge, as shown, and when the valve is closed, the Babbitt ring in the disc rests directly on the brass seat ring. The curved upper edge of the latter lessens the likelihood of scale being caught and held between the disc and the seat. Such action is still further hindered by the construction of the valve body. It will be observed that a shoulder is formed at *g*, and that it extends somewhat above the top of the valve seat. When the valve is open, the disc *d* is drawn up against the yoke, and the water from the boiler, entering the valve at *h*, is discharged at *i*. When the valve is being closed, the descending disc passes the edge of the shoulder *g* before it strikes the seat *f*. Thus, while the valve is not tightly closed at that time, the annular opening between the disc and the valve body is so small as to preclude the passage of any large particles of scale. There is, however, a rush of water under pressure, and this water, sweeping over the valve seat, washes it clean of scale, so that when the disc descends further and meets the brass ring, there is nothing to prevent the making of a tight joint.

The construction of the valve body, seat and disc of the valve illustrated in Fig. 2 is very much like that of Fig. 1. The disc is made so as to slide easily up and down in the cylindrical barrel of the body. A shoulder is formed at *a*, above the valve seat, so that when the disc is descending and reaches the position shown in the illustration, further escape of water through the valve is prevented. It will be seen that the disc must move a slight distance further before it will meet the valve seat. While it is completing this portion of its closing movement, the seat is being cleaned of any mud or scale that may have collected on it. This is accomplished by a steam blast. A small pipe is attached to the valve at *b* and is in communication with the steam space of the boiler. Thus when the flow of water is shut off by the passing of the disc below the shoulder *a*, high-pressure steam is admitted to the annular space *c* surrounding the seat, and the escape of this steam across the face of the ring is relied upon to remove any solid matter that might otherwise keep the valve from closing tightly.

The type of valve illustrated in Fig. 3 has all the advantages possessed by the one in Fig. 1, so far as cleaning the valve seat is concerned. In addition, it is so constructed as to be very durable. The valve proper is of three parts: a yoke *a*, a body *b* and a lower flange *c*. Between the lower flange and the body of the valve the valve seat *d* is placed. It is in reality a ring of T section, and both the upper and lower edges are rounded for use as a seat. The valve disc *e* is also made with two surfaces, each of which contains a soft metal ring imbedded in it. This disc is bolted to the casting above it by a small bolt *f*. Consequently, in case the valve begins to leak by reason of a damaged disc, the bolt *f* may be loosened and the disc reversed, bringing a fresh surface into contact with the valve seat. If the valve seat ring becomes scored, it may also be reversed and the valve made good as new. When both the disc and the seat ring have been worn out, they can soon be repaired. This is done by facing off the edges of the seat ring in a lathe, until all traces of scoring are removed. The disc may be heated to melt out the soft metal, and a new set of rings poured, after which both faces should be turned smooth.

The three valves thus far mentioned are angle valves. The one shown half in section in Fig. 4, however, is a straightway valve, and instead of a flat disc moving in the direction of flow of the water through the seat ring, this valve uses an expansible or wedge plug that moves at right angles to the direction of flow of the water. In the position shown in the figure, the valve is closed and no water can pass from *a* to *b*. The wedge plug *c* is made in two parts, and when the valve is

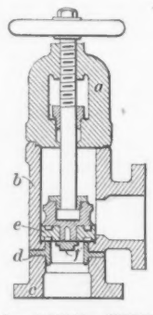


FIG. 3.—VALVE WITH REVERSIBLE DISC AND SEAT.

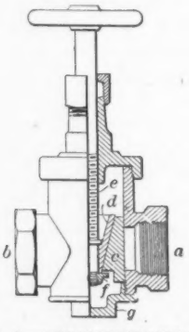


FIG. 4.—STRAIGHTWAY VALVE WITH WEDGE PLUG.

closed, one-half closes the opening from *a* and the other the opening from *b*, thus making practically a doubly sealed valve. The two parts of the plug are divided by the wedge *d* fastened to the valve stem *e* by the nut *f*. When the handwheel is turned in the proper direction to cause the valve to open, the first result is a rising of the wedge *d*, without any motion of the plug *c*. There is a small space between the nut *f* and the

plug *c*, and not until the nut has risen this amount does the split plug *c* begin to rise. On further turning the stem, the plug and wedge are drawn up into the barrel of the valve, leaving a free, full opening for the discharge of water and sludge.

In closing the valve, the plug *c* descends until it strikes the cap *g*, checking the flow of water, though not completely. But, as the handwheel is turned further, the wedge *d* is forced downward between the halves of the plug and presses them hard against their seats.

The peculiar feature of the valve shown in Fig. 5 is the hollow plug, through which the discharge occurs. This plug *a* is conical and fits snugly into the conical body *b*. The discharge from the boiler enters at *c* and passes out at *d*. The valve is opened by giving a quarter turn to the handle *e* attached to the spindle *f*. This spindle is hollow, its upper end connecting with a cock *g* and its lower end with the space *h* between the valve bonnet and the plug *a*. Ports *i*, *i* lead from the space *h* to the interior of the plug. Hence, steam being allowed to enter through the cock *g*, pressure is exerted in both directions on the plug, so that it is practically balanced and will therefore turn easily. A spring *k* presses downward on the plug and keeps it tight in the valve body. The reason for constructing the valve with a central passage for the water is to prevent sediment or grit from coming in contact with the bearing surfaces and thereby cutting them.

A straightway plug valve is illustrated in Fig. 6. The plug *a* is attached to the spindle *b* and has an opening through it equal to the full area of the blow-off pipe. The valve is

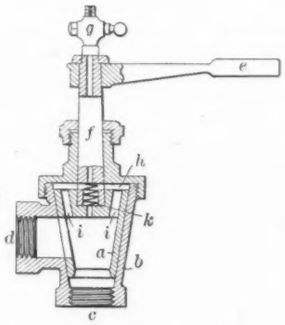


FIG. 5.—BALANCED ANGLE VALVE.

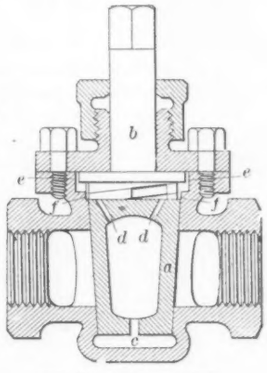


FIG. 6.—PLAIN PLUG VALVE.

opened by giving the plug a quarter turn. Small ports *c* and *d* permit the pressure to be transmitted to the top and bottom of the plug when the valve is open, and the plug is then held to its seat by the excess of pressure on the larger end. By means of lugs *e* and cams *f* the plug is forced tightly to its seat after being turned so as to close the valve. The joints are metal to metal and as there is little contact of water with the wearing surfaces, the amount of abrasion is slight.

A plug valve of similar construction is illustrated in Fig. 7. Here, however, the tightness is secured by means of asbestos packing *a* set in U-shaped grooves in the body of the valve. An asbestos ring *b* is also placed beneath the gland *c*. The gland is tightened by means of bolts, and the plug is thus held to its seat. A quarter turn of the stem *d* opens or closes the valve. A lug *e* is cast on the gland *c* and two shoulders *f* and *g* are formed on the stem. When the valve is fully open, the shoulder *f* strikes the lug *c* and when it is closed, the shoulder *g* rests against *c*. Thus it is impossible to turn the valve too far, either in opening or closing.

An unusual form of blow-off valve is shown in Fig. 8. It is of the straightway class, the flow being stopped by moving a disc across the seat at right angles to the current. The disc *a* is attached to an arm *b* connected to the square-headed stem *c* to which the turning wrench is applied. Thus, in opening or closing, the disc *a* swings in a circular arc, but never leaves the plane of the seat *d*. The inlet is at *e* and the outlet at *f*, so that the boiler pressure holds the valve to its seat. Additional adjustment for wear is secured by the screw *g* which maintains a tight joint between the stem *c* and the body of the valve. A spring between the disc *a* and the arm *b* holds the latter against the upper seat *h*.

A form of plug valve in which the plug is a hollow sphere is shown in Fig. 9. As may be seen, the valve gives a full straightway opening and can be operated by turning the stem a fourth of a revolution. The ball *a* fits nicely against the bear-

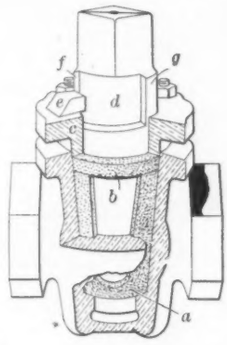


FIG. 7.—ASBESTOS PACKED PLUG VALVE.

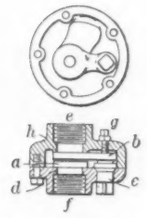


FIG. 8.—DISC BLOW-OFF VALVE.

ing surfaces in the valve body, but in addition adjustments and packing are provided to take up wear and prevent leakage. A ring of soft metal *b* rests against the ball *a*, and behind it is a ring of packing *c* that is compressed by the gland *d*. The metal nipple *e* prevents the soft packing from being squeezed out into the passage through the valve.

The operation of the blow-off valve requires judgment and common sense. With quick-closing valves of the quarter-turn type, a thoughtless or ignorant attendant may close it with a sharp twist of the handle. This is to be condemned as a dangerous practice, since it is liable to cause rupture of the blow-off pipe through water-hammer. The column of water moving through the valve at high velocity possesses considerable energy, and if the column is brought to rest almost instantaneously, as by the sharp closing of the valve, the energy will be given up in the form of a heavy blow against the valve. This may result in a broken valve body or a split blow-off pipe, if nothing worse. The rapidity of opening of a blow-off valve is of little moment, since the water, by reason of its inertia, will be unable to reach a high velocity in so short a time as to cause any damage to elbows or other fittings.

The time of opening the blow-off valve, the length of time

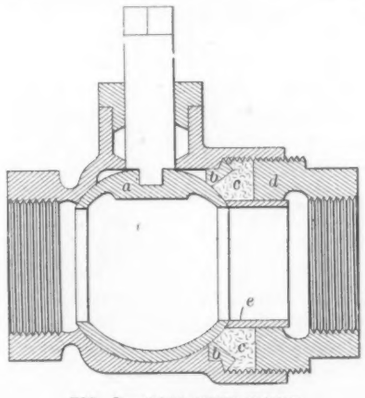


FIG. 9.—BALL PLUG VALVE.

it is left open, and the frequency with which it is opened vary. It is the general practice, however, to open the blow-off when the pressure is lowered, as, for example, in the morning while getting up steam, and before the pressure has reached the normal. The quality of the feedwater, whether dirty or fairly clean, will determine the intervals at which the valve must be opened.

LETTERS ON PRACTICAL SUBJECTS

EXPERIENCE WITH THE CENTRIFUGAL PUMPS.

It is generally well known that the centrifugal pumps cannot produce sufficient vacuum to raise water from a pit when the water level is much below the pump. But it apparently was not known to the people who installed a small pump in the conditions shown in Fig. 1. Of course, the pump would not operate,

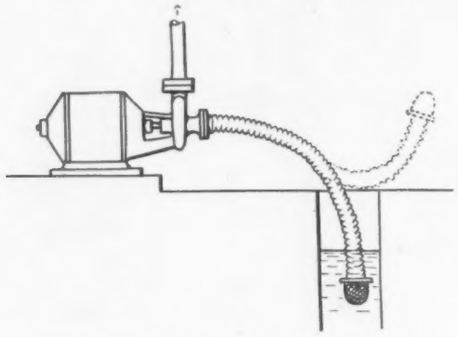


FIG. 1.—ARRANGEMENT OF PUMP SUCTION.

so that when the writer was called to look at the equipment, the owners seemed to be dissatisfied with the pump and with electricity and were about to put at the work a couple of men with hand-operated suction pumps. The pump was a small portable machine for 1050 cu. ft. per hour, with a maximum head of 30 ft. It was fitted with a flexible suction pipe 4 in. in diameter, 15 ft. long, which was apparently too large for such a pump, and the pipe was immersed in a pit with the water about 6 ft. below the pump.

The writer obtained a 2.5-in. pipe and meantime decided to fill the pump with the water before starting. The outgoing pipe had already been removed and the pails with water were at hand. Two full pails were poured in, and after the pump had been started, all of the water came back violently. For the first second it seemed that the whole pit would dry in very short time, but the water stream died out quickly. Apparently it was impossible thoroughly to fill the pump and pipe with water, as it was impossible to close the inlet temporarily, which was quite inaccessible.

The suction pipe was then removed from the pit and raised, as shown by the dotted lines in Fig. 1. Three full pails of water filled the pipe and pump completely. Then the pipe was quickly thrown in the pit, and the pump was started. A heavy, steady stream followed, and when the outgoing pipe was fitted on its place, the pump continued to work successfully.

A similar trouble occurred in another instance when a large vertical pump (for 16,000 cu. ft. of water per hour), installed in the boiler room of a large steamer, refused to work, being

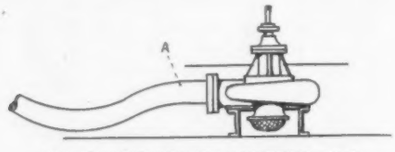


FIG. 2.—AIR-LOCKED DELIVERY PIPE.

completely covered with the water. A considerable increase of speed of the driving motor did not bring any satisfactory results. The pipes, and the pump itself, were carefully examined and nothing could be found which might indicate the cause of the trouble. However, a similar pump in the engine room picked up the water almost instantly after having been started. Apparently there were some obstructions inside the pump which could be found only by removing all parts of it. It was believed that, due to a peculiar shape of the outgoing pipe (see Fig. 2), there must be air locked in the pump so that the water could not come in touch with the blades. A .25-in. hole being drilled at *A*, the air came out whistling, and a fine stream of water after it. Then the pointer of the ammeter in the motor circuit swung from 35 to about 320 amperes, and a full stream of the water went through the outgoing pipe.

East Pittsburg, Pa. J. Nikonow.

A PECULIAR ELECTRICAL PHENOMENON.

While employed some time ago on power-plant construction work it became my duty to install the station-lighting system on a 550-volt direct-current circuit, taking its power from the 225-kw generator used for operating a small street-railway system. When the work was well advanced, and all the different circuits had been connected to the switchboard, we threw the power on for the first time. The incandescent lamps in the different parts of the building lighted up without giving any trouble, but when the arc-lamp switch was closed there occurred a most peculiar electrical phenomenon.

The accompanying sketch shows a diagram of the wiring on the back of the switchboard, and it will be noticed that the main switch controls all of the incandescent circuits, but has nothing whatever to do with the arc-lamp circuit. This arrangement was made because it was thought desirable to have the arc lamps—which were used for the general illumination of the building—on a circuit separate from the incandescents. When the test was made, the main switch was first closed, then

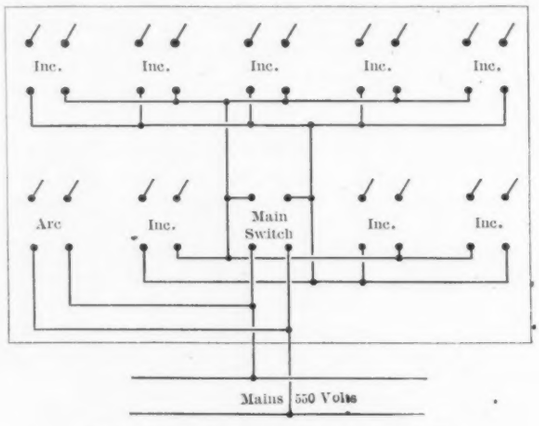


DIAGRAM OF SWITCHBOARD CONNECTIONS.

the different incandescent circuits were thrown on, one by one, until the leads and the main switch were carrying 10 amperes. When the arc-lamp switch was closed, however, there was a blinding flash and every light in the house went out. Upon examining the switchboard, it was found that the fuses in the arc-lamp switch were blown out, and that the switch itself was considerably damaged, but the main switch—which was not in the direct path of the short-circuit—was damaged very much more; in fact, it was nearly ruined, the binding screws being partly fused, and there were evidences that it had carried a much heavier current than the arc-lamp switch. The fuses were also blown on two or three of the individual incandescent switches, but the switches were not harmed.

We put in new fuses throughout, and then carefully inspected the arc-lamp circuit for trouble. We found one place that looked bad and fixed it. The circuit appeared to be all right in every other place, so we gave it another trial. The short-circuit was still there, however, and this time the main switch was completely destroyed—as far as its future usefulness was concerned—and one of the main leads, a No. 12 copper wire, was fused close to its point of junction with the main switch. The arc-lamp switch was badly damaged, but could still be used.

On the following morning I discovered the cause of the accident. The arc-lamp wires had been connected to the switch so that the current flowed through the lamps in the wrong direction. This being the case, the carbons had failed to lift, and

the result was a dead short-circuit. This explained the immediate cause of the trouble, but did not help me to understand why the main switch had been destroyed when, theoretically at least, it should not have been affected by the short-circuit.

Now, why should this be? Why should the current pass through the main switch at all, unless we can assign to electricity the property of inertia. The current is direct, the leads are short, and the phenomena cannot be charged to the account of self-induction. I have thought about this a great deal since the occurrence of the accident, but cannot satisfy myself in regard to its cause. Perhaps some of the readers of this may have had a similar experience, or have made some experiments that would throw light upon this question. If so, I should be glad to have the cause of the phenomenon explained.

CHICAGO, ILL. FRANK W. MERRILL.

THE OPERATION OF A SMALL ELECTRIC PLANT.

The writer has noted a mistake made in the sketch shown of a compound-wound motor in the article by Mr. W. H. Wakeman, in the February number, and would suggest that the figure referred to as illustrating the wiring of a compound-wound, direct-current motor is not correct, as the shunt-field wires are not shown connected to any part of the circuit. Neither is the relative position of the starting-box, or motor-starter, connected in the circuit, and for a man who is trying to learn to do correctly this class of work the sketch is misleading.

I quite agree with Mr. Wakeman that it is very necessary that the wires be properly located and that they be kept in place, as very few electricians who have not had experience with compound-wound motors will be able to handle a motor of this description correctly, providing they wish it to operate in the opposite direction, as invariably, instead of reversing the direction of current through the armature leads, the shunt-field wires are changed.

In order to illustrate the connections for a compound-wound motor, the writer is enclosing two sketches, Fig. 1 and Fig. 2,

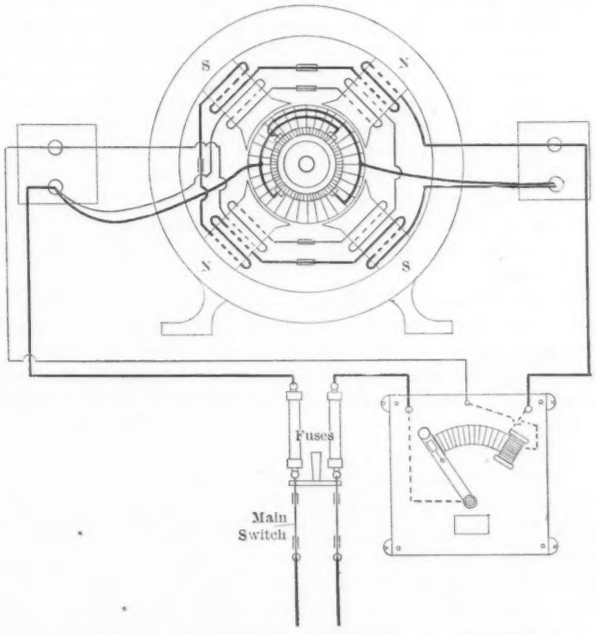


FIG. 1.—CONNECTIONS OF COMPOUND-WOUND MOTOR.

showing the correct connections of such a machine of the four-pole type, with all wires shown on the diagram. By noting Fig. 1 it is readily seen that both the shunt and series coils are connected so the current travels in the same direction, and in order to reverse the direction of rotation of this type of motor it is only necessary to shift the brush-holder yoke one-fourth of its complete revolution, which will then place the brushes so that the armature current is reversed in its direction through the commutator. If the leads are not long enough to allow this to be done, the relative position of the right-hand lead and left-hand lead on the brush studs should be exchanged.

By referring to Fig. 2, a projective sketch, which illustrates the direction of current through the entire machine, it can be readily understood why it is necessary for the two field coils on each pole to carry the current in the same direction, because if they are reversed, the tendency is for the machine to increase in speed as the load is thrown on, owing to the magnetizing effect of the series coils neutralizing the effect of the shunt

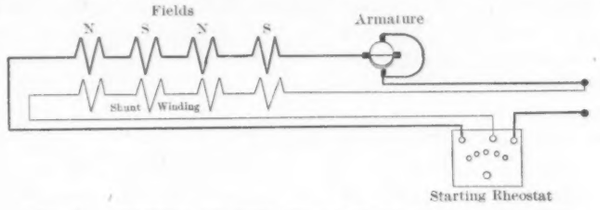


FIG. 2.—DIRECTION OF CURRENT THROUGH ENTIRE MACHINE.

coils attempt to strengthen the fields, and the result would be the destruction of armature, caused by increase of speed and decrease of counter e. m. f.; this action depending, of course, upon the extent of the compounding.

In Fig. 1 the main switch and fuses are shown. It should be pointed out that link fuses are not permitted in many localities owing to wiring regulations, and the tendency of inexperienced operators to replace link fuses of one size with a larger size than the wires and fuse blocks are built to carry is censurable. With approved enclosed fuses it is impossible for the operator to replace fuses in a block with fuses of a much larger size because a fuse of one class will not fit in a cut-out block of another class.

KANSAS CITY, MO. RALPH B. COLEMAN.

SETTING OF DYNAMO BRUSHES.

I have read an article by Mr. Gardeen in the February issue, and I think there is yet something to be said with regard to brush-setting on generators.

The brushes should be set first on what is termed the mechanical neutral, which is obtained as follows: Tie a string to the head of one of the bolts which hold the poles in place and, holding the other end at the center of the end of the shaft, sight across this string to the center of the pole piece (previously marked with a piece of chalk). The mechanical neutral is in this straight line, and the brushes should be placed in such a position on the commutator that the centers of the brush, or brushes, on the particular stud come in this straight line as projected on the commutator. (This brush-setting applies for armatures in which the commutator bar is 45 electrical degrees ahead of the armature conductor to which it is attached. Practically all armatures are now wound in this manner.)

Having set the brushes as described above, the machine may be started up. If wired according to the print, which accompanies it, the machine should now build up. Next adjust the field current until approximately no-load normal voltage is obtained, and then shift brushes in the direction of rotation until black commutation, i. e., no sparking, is obtained. The brushes are now on the no-load electrical neutral. The position of electrical neutral is changed, however, as the load comes on the generator so that our no-load setting no longer gives sparkless commutation. The brushes must be carefully moved in the direction of rotation until black commutation is again obtained; now shift brushes back a trifle until sparking is just perceptible. In most cases this setting will be found the most satisfactory one. The generator will run under load the greater part of the time and therefore a brush setting which gives almost sparkless commutation under load will be the most economical, provided the no-load sparking is not bad.

Great care should always be used in shifting brushes on motors or generators under load, as too much shift may cause the machine to arc over, with serious results to both machine and operator.

In the case of a series generator we have somewhat different conditions, because normal voltage is obtained only under load. In this case we have two conditions to fill in our brush-setting —we want a given voltage and also good commutation. Shifting the brushes changes both the voltage at the terminals (and consequently the load) and the degree of sparking. The position which gives the best commutation may or may not be the position that gives normal voltage at full load. The latter is usually the case, and the brushes must then be tried in several positions until that position is found which most nearly fulfils both conditions. This requires good judgment on the part of the operator.

Sayre, Pa. Howard E. Bishop.

USING A GASOLINE TORCH.

The gasoline blow-torch is a very handy tool to have around a central station, and it is to be regretted that more engineers and mechanics do not understand that appliance better than they do. Only recently I watched a man use a torch and could not but wonder where his brains were, if he really had any gray matter at all.

The misuse of the tool commenced when it was being filled with gasoline. The tool was up-turned and the filling plug unscrewed, then the torch was propped up against a box, while the gasoline was poured into the body of the torch. A 5-gal. can of gasoline necessitated the use of both hands to hold it, hence the necessity for propping up the torch for filling. The props being insufficient, the torch fell down when partly filled and some of the gasoline was spilled.

One should never try to fill a torch from a big can. A pint or quart dish should be used for the purpose. Then the appliance can be held in one hand and filled with the other without over-filling the tank and spilling a lot of gasoline. The torch should be a little more than two-thirds full, so that there will be room for a little air in the torch and so that pumping will not have to be performed so often as when the reservoir is filled to the very top with gasoline. When there is only a thimbleful of air in the tank, the pressure falls very quickly and frequent pumping is necessary until the tank empties a little.

Pliers should not be used to unscrew the filling plug of a torch. There is a hole through the plug for putting in a screw-

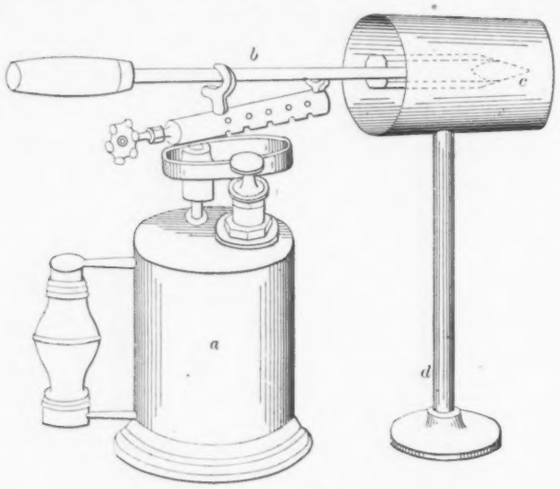


FIG. 1.—QUICK HEATING ATTACHMENT.

driver or a round iron rod. A rod should be employed for that purpose, or a monkey-wrench, which is better than either screwdriver or rod.

Do not use matches when starting the gasoline torch at the bench, if there is a pair of test plugs hanging over the bench and these are connected through lamps. Just touch the plugs against the torch and draw an arc on the edge of the gasoline. It is much safer than matches.

When a gasoline torch is used, 90 per cent of the heat goes off in the atmosphere without doing any work whatever. When performing certain operations it is easy to save a little of this heat. Fig. 1 shows how this can be done when heating a soldering copper. Not only is the heat saved, but the tool is heated in one-third the time necessary without the heat-saving appliance, which is merely a shield of iron or asbestos placed on a stand as shown, and so located that the tool can be heated inside the shield. The torch is represented at *a*, the soldering copper handle at *b*, the copper itself is seen inside the shield *c*,

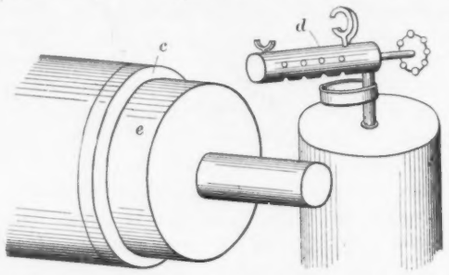


FIG. 2.—WASTE OF HEAT WHILE UNSOLDERING ARMATURE WINDING.

which is held where wanted by the stand *d*. The shield may be used for a little job of brazing, and a tremendous heat gotten up inside it if a few pieces of charcoal are placed inside the shield and the blast turned loose against the charcoal.

It is sometimes necessary to unsolder the connections of an armature, and this has to be done by unsoldering the wires from each segment. The workman usually places the torch as shown in Fig. 2, and then sits down for half an hour while a little heat goes into the commutator bars, etc., from the torch *d*, most of the heat passing by the work and never doing a particle of good.

The solder may be melted out in one-fourth the time usually taken for it by placing a piece of asbestos board on the commutator bars at *e*, to protect them from unnecessary heat, and piling a few large pieces of charcoal on top of the soldered connections, directing the torch blast into and under the charcoal. The heat will be increased many fold and the top of the armature will resemble a smith's forge in full operation. If charcoal cannot be obtained, a few pieces of wood placed around and over the soldered connections will be quickly converted into charcoal, which will ignite and very quickly add to the heat sent against the commutator connections. If no asbestos board is at hand to place over the commutator at *e*, common sheet-iron may be used, and it is also well to place a piece of sheet-iron on top of the asbestos when the latter substance is used, the iron serving to protect the asbestos from damage through hard usage.

When getting the torch ready for use, and when setting it aside, the filling plug should always be screwed firmly home. Many a time has a torch been picked up by the writer and a wet spot of gasoline-soaked wood found below the appliance. Such carelessness may lead to fire, and should not be countenanced.

Boston, Mass. John Jackson.

THE CENTRAL-STATION BOILER ROOM.

It is too often forgotten that in the operation of steam-power plants, if economical operation is to be striven for, the battle must begin in the boiler room, and the "man behind" the scoop is a personage of greater importance than is generally conceded. What follows are a few simple hints that I have found to improve the work of some old and fairly successful firemen—as firemen go.

Suppose the fireman has been called upon to push his fires in order to carry a heavy overload. It will be necessary to burn a large amount of fuel, and necessitates heavy firing, not slugging, but frequent firing, placing the required amount of fuel on the fire at proper intervals, and a strong draft will be required. Now, when the load lightens two things should be done. The fireman should place less fuel on the fire and reduce the draft, because with the thinner fire the strong draft would cause too much air to be drawn through the bed of fire, cooling

the gases of combustion and causing heavy loss. Besides, the amount of heat absorbed by the boiler heating surface from the gases of combustion depends upon the time they are in contact. The more slowly the gases pass by or through the boiler surfaces, the more heat will be taken up from them and conveyed to the water in the boiler. Hence no more draft should be used than is required to secure good combustion. Where the fireman regulates the supply of water to the boilers, he should endeavor to feed them as nearly uniformly as possible. This will make possible more regular firing, and will avoid the evils due to rapid changes of temperature of the boiler and furnace. If a heavy load comes on, first push the fires, then when the effect of this is seen, increase the feed-water supply. If the feed-water supply is increased first, a heavy fall in pressure will result. I always advise firemen to get in the habit of glancing at the steam and water gages every few minutes. This requires practically no exertion of the body; close observance will enable the fireman to detect the slightest tendency of the pressure to rise or fall, and he can constantly govern his firing by these indexes. Watchfulness and willingness, with a fair degree of common sense, will make a good fireman.

The fireman should learn the color of a good fire. When he opens a furnace door and sees a white incandescent mass, he is getting heat. If he sees dense clouds of smoke floating over the

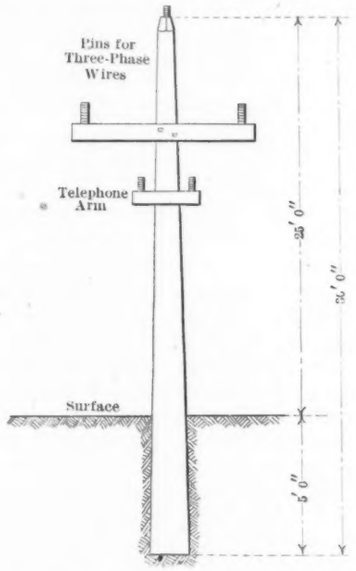


FIG. 1.—ELEVATION OF POLE.

grates, mixed with a dull or dark red flame, there is little heat. Most of the free gases are going up the stack in the form of soot instead of combining properly and giving up their heat to the furnace in the boiler.

In placing coal on the fire I advise beginning at the back of the fire, placing the first scoopful back against the bridge-wall, scattering it well, and then firing toward the front. In this way the uncovered portion of the fire can be perfectly observed, and every scoopful of coal can be placed to a nicety. If the first scoopful is placed near the doors in front, the smoke rising from the fresh coal, if it be soft or bituminous, which I have in mind, will obscure the portion of the grate that has yet to be fired, so that the last scoopfuls cannot be placed with any certainty at all.

BURLINGTON, IA. WM. WESTERFIELD.

ECONOMICAL POLE RAISING.

An engineer in charge of an electric generating station, operated by a gold mining company, located in a particularly rough and rugged part of Colorado, was once required to build a pole line of 30-ft. poles (such as shown in Fig. 1), about a mile in length. The contour of the route was such that the upper end of the line, at the mine, was at least a third of a mile higher than the lower end, at the generating station. The engineer had one experienced lineman and three laborers to assist him. It was not thought best to secure additional help, if it could be avoided, as the cost of labor was very high, a common laborer receiving $3 for ten hours' work. The problem was to build the line with this force.

Fortunately, all of the poles could be set in a straight line which necessitated no guying except at the extremities. Loca-

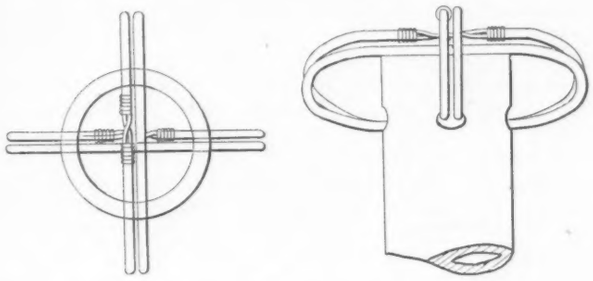


FIG. 2.—PLAN AND ELEVATION OF PIPE END.

tions for the poles were carefully staked out and lined up with a transit. No attempt was made to secure a uniform spacing of poles, as the hillocks, ravines and low cliffs would have made such refinement out of the question. Points were so chosen for pole locations that the grade of their tops was fairly uniform. It was a comparatively simple, though tedious, matter to locate the poles and dig the holes for them with the labor available, and the poles were snaked to the points where they were to stand by contract. The tough proposition was how to set them. Even if the pole-raising pikes had been at hand, which they were not, it would have been very risky to have tried to raise poles with them on a very steep hill with inex-

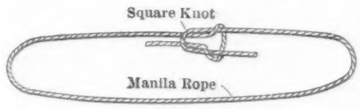


FIG. 3.—METHOD OF MAKING SLING.

perienced hands. If a pole had got away, it would not have stopped until it reached the bottom of the hill, and likely someone would have been killed in its descent, as the pole line crossed a much frequented trail several times. So great was the inclination of the hillside that in a great many instances it would have been impossible, in any event, to have lifted the pole near enough to the vertical with pole pikes to have insured its falling into its hole.

The following is a description of the method in which the poles were raised. The engineer prepared one end of a 12-ft. length of 2½-in. wrought-iron pipe as shown in Fig. 2. Four

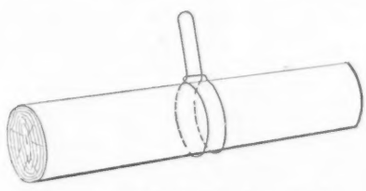


FIG. 4.—SLING APPLIED TO POLE.

½-in. holes were drilled 90 deg. apart and about an inch from the end of the pipe, as illustrated. Through each opposite pair of holes a double loop of No. 6 gage galvanized iron wire, such as is frequently used for guying, was passed and each loop spliced with a "Western Union" splice. One hook of a set of tackle blocks was let into one of the loops and a ¾-in. manila guy rope was tied securely into each of the remaining three loops. A sling of manila rope made as indicated in Fig. 3 completed the equipment.

Fig. 5 is intended to show how the poles were raised with the iron pipe "Jim-pole," the latter term being the technical name of the apparatus. Two men could easily carry the pipe, with its rigging, up the hill, from pole location to pole location. When the point where a pole was to be raised was reached a man would hold the pipe, its lower end on the ground, in an almost vertical position, the foot of the pipe being about 12 in. from the mouth of the pole hole. Other men made fast the guy ropes to trees, stumps, rocks or anything available. The sling being adjusted on the pole, slightly above the point of balance, about one-third of the length from the butt, three men would raise the pole by pulling on the tackle line, while a fourth guided the butt and inserted it in the hole as soon as it had been raised sufficiently. The pole was then pushed into a vertical position with long-handled shovels, or pulled into such a position with temporary guy ropes, which had been attached before raising, and the hole filled and the dirt thoroughly tramped in. The method proved to be thoroughly practical and a cheap one, and although the pipe bent threateningly at times (a 30-ft. pole weighs in the neighborhood of 450 lb.), it always assumed its normal lines when the strain was relieved. It was necessary frequently to set the base of the pipe on a piece of rock about 6 in. square to prevent its sinking into a yielding soil. After

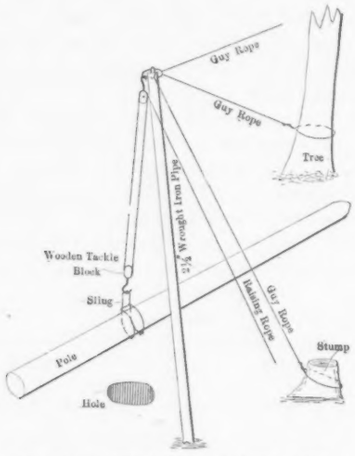


FIG. 5.—METHOD OF RAISING POLE.

the line was completed, as far as could be judged, the pipe was as good as new except for the holes.

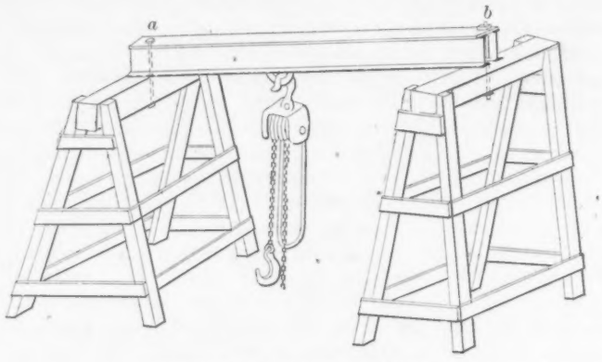
There is no reason why a similar arrangement should not be used frequently, even under less exacting conditions, as there is no question as to the economy if objects are handy to which the guy ropes may be secured.

Waterbury, Conn. T. C. Lerret.

A REPAIR JOB TROLLEY.

During some recent rush repairs made necessary by excessive wear of the shaft of a direct-connected, direct-current generator it became necessary to put in a new shaft between Saturday and Monday, and as there was no overhead crane, the handling of the generator field structure, the armature and the shaft itself was quite a problem. Two 10-in. I-beams 12 ft. long were fastened side by side and fitted with a trolley to which was attached a three-ton differential hoist. Two stout horses were prepared, each being built of a 6-in. x 8-in. timber 8 ft. long, the legs being made of 3-in. x 6-in. scantling, well braced and spiked together, and finally being bolted to the 6-in. x 8-in. backbone. The I-beam trolley run was placed on top of the trestles, and each end of the I-beam was fastened to one of the trestles by means of a bolt, as shown herewith.

The bolts *a* and *b* were the features of this piece of apparatus. The bolts were not very tight, they were left loose; but the nuts were in place and screwed down so that there was not more than ½-in. play between the I-beam and the bolt-head. In fact, the bolts were merely used for keeping the I-beams in place upon the trestles while the latter were being shifted from one position to another to accommodate the work to be done. The entire rigging was easily moved around the floor by four men, and when a piece of machinery was to be lifted into or out of place the trestle was pulled around until



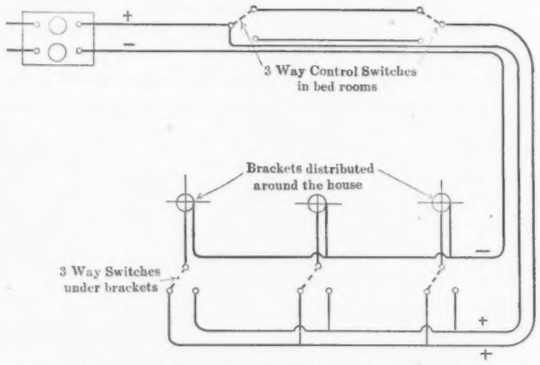
A RUSH-JOB TRESTLE TROLLEY.

the I-beams were directly over the piece to be moved and the place to which it was to be moved. It was then an easy matter to raise the mass by means of the tackle and shift it to its new position by means of the trolley.

Philadelphia, Pa. Henry Fuller.

EMERGENCY LIGHTS FOR RESIDENCES.

In the wiring-up of residences, it is very desirable to install a number of emergency lamps distributed around the house and controlled by a switch or switches in the bedrooms, so that general illumination throughout the entire house may be had at a moment's notice in case of emergency. Heretofore, the chief objection to this plan was that these special lamps were not available for any but emergency purposes. This is objectionable as it looks bad to have certain lamps in the room which cannot be lighted for general illumination purposes. This defect may be overcome by installing the wiring as shown on the accompanying drawing. The idea is that emergency lamps have three wires run to them. The first wire is a common negative; the second wire is positive and connected up to the emergency switch or switches in the bedroom; the third wire is also positive, but shunted around the emergency switches in the bedrooms. Each emergency lamp is provided with a three-way switch which acts as a double-throw single-pole throw-over switch. In order to use an emergency lamp for general illumination, energy is supplied to it by means of the common neutral and the third positive wire shunted around the emergency switch, as described above. It is obvious that when an individual



WIRING DIAGRAM FOR EMERGENCY BURGLARY LAMPS.

emergency lamp is switched into circuit by means of the three-point switch directly under it, it is thrown on the emergency circuit so that it can be controlled from the emergency switches in the bedrooms.

Chicago, Ill. George H. Jones.

QUESTIONS AND ANSWERS

Kindly advise me through your columns how to paint galvanized iron signs so as to keep them always white. I am unable to locate the number in which this valuable information was given. W. W.

This information appeared on the Questions and Answers page of the September, 1906, number.

What is the composition of the alloys used for thermostats? E. E. & S. Co.

The best material for thermostats consists of a strip of tool steel backed by a strip of either copper or brass. We do not know the composition of alloys used for this purpose.

What size of wire should be used in grounding the alternating system of a residence? N. S. E.

The code specifies a wire not smaller than No. 4 B. & S. gage. The wire should have an approved rubber insulation and be connected to pipes on the street side of water meters, gas meters, etc.

In the January number directions were given for making a dry battery. Can old arc lamp carbons or discarded dynamo brushes be used for making the powdered carbon filling? H. C.

Yes. It would be well to place the carbons in boiling water for some time, and then permit them to dry well before they are converted to the powdered form.

If a transformer designed for 1100 volts primary and 110 volts secondary be connected to a 2200-volt primary circuit, thus obtaining a secondary e.m.f. of 220 volts, would the transformer overheat? E. B. H.

A transformer thus connected would give the desired voltage without affecting the efficiency appreciably. The iron loss, however, will be three times its normal value, and the temperature rise will be excessive and probably destructive.

Is it possible to ring four bells from three single push buttons as follows: Push button No. 1 to ring bell No. 1; push button No. 2 to ring bells Nos. 2 and 3, and push button No. 3 to ring all four bells at once, provided a series arrangement is used? M. W. H.

By arranging the bells in series and providing the necessary number of cells, the desired combination of bells may be rung with single push buttons. The arrangement, however, is not the best, and unless some of the vibrators of the bells are short-circuited satisfactory operation cannot be expected. A better arrangement was suggested to "B. R" in the January number.

I had occasion to rewind a 250-volt series railway-type, motor armature having 45 slots, three coils per slot. The coils were wound in slots one and eleven, and I would appreciate it if you would inform me why they were not placed in slots one and twelve, the motor being a four-pole machine. F. M. M.

In a four-pole armature containing 45 slots, it is not essential to place the coils in slots one and twelve; although the operation will probably be satisfactory if they are so placed. When the coils are arranged in slots one and 11, each coil requires less copper than when placed in slots one and 12, and the commutation is somewhat better. The only requisite in winding an armature is that one side of the coil shall be under a north pole when the other side is under a south pole. It is not essential for one side to be under the middle of the north pole when the other is under the middle of the south pole; in fact, it is preferable for the throw of the coil to be shortened somewhat.

I have lately seen references to a device for testing the condition of wire hoisting ropes by means of electricity; the induced current crossing the wire being said to vary with the thickness of the cable. Where can I obtain particulars of such a device? E. R. C.

The arrangement for testing the cross-section of wire rope is probably that suggested by Mr. C. McCann before the Transvaal Institute of Mechanical Engineers. It consists of a transformer whose primary is connected to an alternating-current circuit, while the secondary is in series with an ammeter and a coil wound on a hollow bobbin. This coil is placed around the rope, whose cross-section is to be determined. The self-induction of the secondary circuit is low when the rope is not passing through the coil, but rises when the rope moves, causing a decrease in current in proportion to the self-induction produced. The instrument can be calibrated for any particular size of rope as required, and any appreciable decrease in the diameter of the rope can be noticed at once if the coil is kept permanently around the rope.

In handling two standard makes of transformers we have invariably connected them in delta, and whenever we have tried to couple them to the same secondary busbar all of the high-tension fuses have blown. Can any reason be assigned for such action? A. P. L. S.

There are a number of causes to which the result might be attributed, such as inequality in transformation, ratio, etc. It is probable, however, that the secondary delta circuits for one set of three transformers give a voltage that is 180 time-degrees out of phase with the voltage of the other set; that is to say, the secondary voltages of the one set of transformers are in proper three-phase relation, as is true also of the secondary voltages of the other transformers. One set of delta-voltages is reversed from the other side, so that it is impossible to connect them in parallel. We suggest that you close only one of the three switches of one set of buses so as to connect the two delta-voltages at one point. Then with a voltmeter measure the e.m.f. across the other switches before closing them. You will find, doubtless, that the latter voltages, which should be zero, have, in fact, double the normal value between phases. If such is the case, then each secondary coil of one set of three transformers must be reversed before the three are connected into a closed delta.

I would like some information on the following: A test for core loss on a 100-kw, 12,500-2200-volt, 25-cycle transformer showed the following results: Primary 11,170 volts, 1.08 amperes, 2122 watts or 17.6 per cent power factor. The secondary showed 2185 volts, 5.12 amperes, 1430 watts or 12.8 per cent power factor. (1) How much load (non-inductive) would be required on the secondary of two such transformers connected in open delta, three-phase, to give a power-factor of a little over 50 per cent on the primary side? (2) How much load would be required if three transformers were connected in delta to give the same results? (3) How much load would be required if three transformers connected in star were used? (4) Are there any formulas for determining the above results when the excitation current and power-factor are known? (5) Would the total core loss of three such transformers connected in delta be three times the primary loss of one or would it not be three times the primary loss of one plus three times the secondary loss of one; in other words, would not the total core losses be the total of both primary and secondary losses of all three? S. R. S.

If the transformer above mentioned is operated with its primary at 12,500 volts and its secondary on open circuit, it will consume a certain number of watts. If, now, as a second test, the transformer be operated with its secondary at 2200 volts and its primary on open circuit, it will consume exactly the same number of watts. Just why you should have received two different values of watts, we do not understand. However, if it is correct for us to assume that the value 2122 watts was obtained with the secondary on open circuit, and that the power-factor under these conditions was 17.6 per cent, and the primary current was 1.08 amperes, then the first question can be answered as follows: The primary current may be considered as consisting of two components, a power component and a wattless component. The power component is equal to the actual reading of the ammeter multiplied by the power factor; that is, it is equal to 1.08 amperes multiplied by 0.176. The wattless component is equal to the same current multiplied by the sine of the angle of which the power factor is the cosine. This current remains practically constant at all loads. When the power factor is 50 per cent, the sine of the angle, of which 0.5 is the cosine, is .866. Divide the value found for the wattless component by .866 and the result is the power component of the total primary current, and the no-load component of the primary current, as found above, is the load components of the current when the power factor is 50 per cent. The difference between this total power component of the primary current, as found above, is the load component of the current when the power factor is 50 per cent. The above method is applicable to transformers when used in any connection whatsoever. It, therefore, applies to each one of the three transformers connected in either star or delta. The core loss of a transformer depends solely upon the flux at which the core is operated. This flux varies with the voltage, and if the voltage on any one coil of a transformer remains constant when the transformer circuits are changed from single-phase to three-phase, either star or delta, the core loss is unaltered.

Suggestions for Obtaining New Motor Business.

By Norman G. Meade.

It is now generally recognized that electric drive is by no means confined to the operation of industrial establishments, as there are many other fields that have been invaded with marked success. The use of electric motors in office buildings, hotels, department stores, restaurants, cafés, laundries, bakeries, banks, amusement parks, etc., is greater than is generally known, as steam and gas engines have been largely superseded by motors for the operation of all classes of apparatus, and many operations formerly laboriously performed by hand are now accomplished by motor-driven machines with a considerable saving in operating expenses. The large demand for electric motors may be attributed to their inherent characteristics which appeal to all power users; their cleanliness, noiseless operation, simplicity of control, the minimum amount of attention necessary and their economical operation rendering them especially applicable to work of all classes and making available power for use in many places where other forms of power would be out of the question.

In the industrial field the electric motor is now being recognized as the ideal power and extends into all branches. It is a well-recognized fact that with the advent of modern manufacturing methods and the introduction of new and labor-saving machinery, operating conditions have so changed that the transmission of power from a central source, such as steam and gas engines or water wheels, is open to many objections, and electric motors have been substituted as a fitting accompaniment to recent progress. By their use long lines of shafting are eliminated, thereby saving the power consumed in overcoming friction, adding to cleanliness, removing obstructions to the diffusion of light, both natural and artificial, and greatly increasing available head room by dispensing with a large number of belts and countershafts. Furthermore, flexibility is gained that permits the operation of a few or many machines each independently of the other, the control being placed conveniently in the hands of the operatives. There are many other direct and indirect advantages which, together with economical operation by reason of increased production, have commended electric motors to all progressive manufacturers.

FIG. 1.—ELECTRICALLY-OPERATED COIN COUNTERS IN A LARGE BANKING HOUSE.

The rapid invasion of electric drive into all fields of business is largely due to the energetic efforts of manufacturers and central stations to enlighten power users as to the possibilities for improvement by the use of motors. It is surprising to note the great strides made in cities where an energetic campaign has been carried on. Many people have to be educated up to the adoption of modern methods and this can only be done by persistent and intelligent effort on the part of those interested in the advancement of some particular branch of industrial progress. It frequently takes considerable time to overcome the prejudices of a large number of people approached, but well-defined arguments and persistence are the key-note to success.

In a previous article the importance of increasing the day load of central stations was considered and a few suggestions made for conducting a new business campaign. To insure success, the new business department must be carefully organized and a definite plan of action mapped out. Local conditions will influence the programme of activity, but in all cities there are innumerable possibilities for extending the motor business.

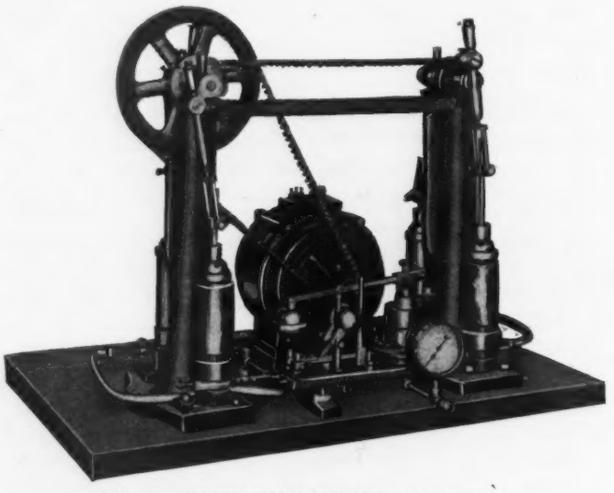


FIG. 2.—ELECTRICALLY-OPERATED BEER PUMP.

The corps of solicitors should work under the guidance of a competent manager who is capable of handling the advertising and publicity work. It is always well to classify the manufacturing interests of a city and divide them into groups, detailing one solicitor for each group. In this way each man can familiarize himself more fully with his particular branch of the work and the requirements, advantages of electric drive,

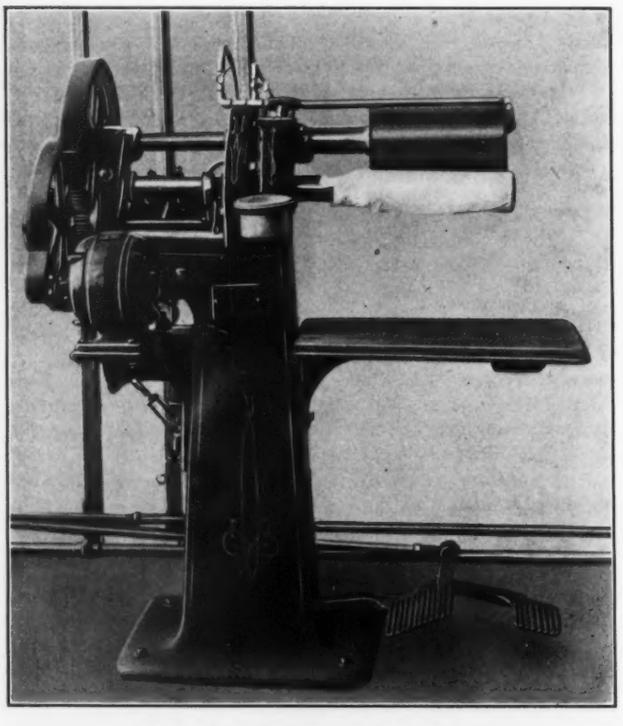


FIG. 3.—MOTOR-DRIVEN SLEEVE IRONER.

etc., for each industry. Every new business department should be provided with lists of possible individual motor applications, industrial and business houses where motor drive is applicable and a separate list of industries with the various machines used, that are adapted to electric drive, classified under their particular head. The great advantage of such lists is that they really serve as a directory of electrical applications which may be added to continually. It is impossible to keep in mind the great number of machines and industries, and work would be carried on more or less at random without their aid. The solicitors should be instructed to be constantly on the watch for information of value that may be filed for future reference.

The following list of motor applications is fairly complete and will serve as a guide for new business departments:

Addressing machines, advertising devices (moving), air compressors, automatic piano-players, barrel washing and scrubbing machines, beer pumps, blowers, blue-printing machines, bottle cleaners, bread-crumbing machines, bridges (roller, lift and swing), buffing lathes, cable covering machines, cake mixers, candy pullers, capstans, car-wheel grinders, carpet-cleaning machines, cash carriers, centrifugal pumps, churns, circle swings, coal cutters, coal crushers, cocoanut grinders, coffee grinders and roasters, concrete mixers, corn shellers, cream separators, deep-well pumps, derricks, dough mixers and kneaders, dumb waiters, egg beaters, elevators, emery wheels, envelope machines, envelope sealers, escalators, fans, feed grinders, floor planers, floor polishers, flour rolls, fodder cutters, fruit-cleaning machines, fuel economizers, grain driers, grindstones, hay baling presses, hay cutters, hay forks and hoists, hoists for all purposes, horse-clipping and currying machines, ice cream freezers, ice crushers, ice handling machinery, knife grinders, lathes, looms, machine tools, mailing machines, marble lathes, meat choppers, merry-go-rounds, monotype machines, moving platforms, organ blowers, paint grinders, paper-bag machines, plunger pumps, printing presses, refrigerating machines, roller coasters, saw sharpeners, sewing machines, "shoot the chutes," stone crushers, stone dressers, stone planers, talking machines, vegetable graters, ventilating fans, washing machines, winches and wringers.

The above list relates, of course, to individual applications. The following schedule gives the industries and business establishments where electric drive can be advantageously used:

Addressing agencies, amusement parks, astronomical observatories, automobile works, bakeries, banking houses, blacksmith shops, blast furnaces, bleacheries, blue printing establishments, boiler manufacturing plants, book binding plants, boot and shoe manufacturing plants, bottle manufacturers, brass goods manufacturers, breweries and bottling works, brick yards, calico print works, candy manufacturers and confectioners, car works, carpenter and woodworking shops, carpet mills, carriage works, chocolate manufacturers, churches, cider mills, cigar factories, clothing manufacturers, cement mills, cold storage, concert halls, contractors, copper goods manufacturers, cork manufacturers, cotton mills, cotton seed oil manufacturers, creameries, dairies, department stores, docks, drop forge manufacturers, drug stores, drygoods stores, dyeing establishments, electrotypers, engravers, ferry slips, filtration plants, flour mills, foundries, furniture manufacturers, gas and steam fitters, glass manufacturers, grain elevators, grain and feed mills, hardware manufacturers, harness manufacturers, hat manufacturers, hospitals, hotels, house cleaning concerns, ice cream manufacturers, ice harvesting plants, ice making plants, jewelers and opticians, knitting mills, lace mills, laundries, libraries, livery stables, machine shops, marble works, markets, manufacturers of small tools, office buildings, packing houses, paper box manufacturers, paper mills, parks, one-cent arcades, photographers, piano manufacturers, pipe manufacturers, planing mills, plate glass works, plumbers, post offices, powder mills, printing establishments, railroad shops, residences, restaurants, rope and cord manufacturers, rubber manufacturers, saloons, sash and door manufacturers, sausage manufacturers, saw mills, schools and colleges, ship yards, shirt and overall manufacturers, silk mills, silverware works, soap manufacturers, stamping companies, steel mills, stone quarries, sugar manufacturers, tack works, tailoring establishments, tanneries, tent and awning works, textile mills, theaters, thread manufacturers, tobacco works, tube mills, wagon works, wire and cable manufacturers, woolen manufacturers and yarn mills.

So far the industries and applications have been classified separately. To fully complete the schedule there should be another sheet prepared showing the individual applications classified under the various industries somewhat in the following manner:

ACCOUNTANTS.

Adding machines, tabulating machines.

ADDRESSING AGENCIES.

Addressing machines, envelope sealers, paper cutters and printing presses.

ADVERTISING SPECIALTIES.

Revolving show cases, shifting sign boards, sign flashers, illuminated arms for window display, illuminated revolving barber poles, duplicating typewriter for window displays, fan motor to blow toy balloons for window displays.

AMUSEMENT PARKS.

Merry-go-rounds, roller coasters, shoot-the-chutes, aerial swings, carousels, pumps, moving pictures.

APARTMENT HOUSES AND FLATS.

Automatic pianos, refrigerating and ice making machinery, sewing machines, elevators, dumb waiters, air compressors for cleaning, exhaust pumps, washing machines, lawn mowers, automobile storage battery charging sets, carpet sweepers.

ASSAYERS AND CHEMISTS.

Separators, shakers and stirrers, crushers, pumps, fans and blowers.

AUTOMOBILE AND BICYCLE SHOPS.

Storage battery charging sets, hoists, buffing wheels, lathes, saws, emery straps, emery wheels, portable and stationary drills, blowers for brazing, tire pumps, automatic oiling devices.

BAKERS.

Cake mixers, dough kneaders, brakes, biscuit cutters, molding machines, flour blenders, ice cream freezers, fans, blowers, hoists, conveyors.

BANKS.

Adding machines, tabulating machines, addressing machines, envelope sealers, letter openers, coupon cutters, time stamps, ticket stampers, telautographs, fans.

BARBER SHOPS AND HAIR DRESSERS.

Massage machines, air compressors, shoe shining machines, fans, illuminated revolving barber poles.

BILLIARD AND POOL PARLORS.

Time stamps, cue chalkers, fans, blowers, dumb waiters.

BLACKSMITHS AND WAGON MANUFACTURERS.

Bellows, tire setters, portable drills, drill presses, punches and shears, hammers, saws, lathes, planers, hoists, fans, blowers, emery wheels, automatic oiling device.

BLUE PRINTING ESTABLISHMENTS.

Blue printing machines, fans.

BOAT AND SHIP BUILDERS.

Windlass, portable drills, steering gear.

BOILER MANUFACTURERS.

Portable drills, boiler shell drills, automatic oiling devices.

BOOK BINDERS.

Printing presses, paper cutters, ruling machines, stitching machines, folding and stapling presses, hoists, rabbeting saws, fans, blowers.

BOOT BLACKING STANDS.

Shoe shining machines, hat cleaners, fans.

BOOT AND SHOE MANUFACTURERS.

Sewing machines, button machines, stitch separators, skivers, edgers, rollers, sand paper wheels, burnishers, fans, blowers.

BREWERIES AND BOTTLING WORKS.

Bottle soakers, bottle cleaners, crowning machines, labeling machines, pasteurizers, centrifugal pumps, mash mixers, rice cookers, grain driers, sack fillers, hop shakers, hoists, conveyors, refrigerating machines, carbonating apparatus.

CARPENTER AND WOODWORKING SHOPS.

Molders, molder and panel raisers, lathes, band saws, circular saws, grindstones, jig saws, planers, fans, blowers.

CEMENT MILLS.

Conveyors, kilns, coolers, coal crushers, tube and ball mills, tramways, sacking machines.

CHURCHES.

Organ air compressors, fans.

CLEANING AND DYEING ESTABLISHMENTS.

Centrifugal wringers, ironers, dyeing machines, washing machines, air compressors for cleaning, feather cleaners.

CLOAK AND SUIT MANUFACTURERS.

Sewing machines, buttonhole machines, bobbin winders, cloth cutters, pattern cutters, fans.

COFFEE AND TEA MERCHANTS.

Coffee grinders, coffee roasters, coffee cleaners, whips and hoists, fans, blowers, exhaust fans.

COLD STORAGE AND PRODUCE DEALERS.

Ice and refrigerating machinery, hoists, elevators.

COMMISSION MERCHANTS AND MARKETS.

Meat grinders, meat cutters and choppers, horse radish graters, elevators, ice and refrigerating machines, fans.

CONCRETE MANUFACTURERS.

Concrete mixers, sand elevators, rotary screens, pumps, concrete presses.

CONFECTIONERS AND CANDY MANUFACTURERS.

Candy pulling machines, candy spinning machines, rolls, candy cutters, candy mixers, grinders, chocolate mills, cream stirrers, candy presses, candy shredders, ice cream freezers.

CONTRACTORS AND BUILDERS.

Portable drills, saws, hoists, elevators, stone dressers, floor polishers, floor planers, concrete presses, concrete mixers, stone crusher, excavator.

DAIRIES AND CREAMERIES.

Churns, cream separators, milking machines, ice cream freezers, fans, pumps.

DENTISTS.

Drills, grinders, lathes, buffers, bone saws, fans.

DEPARTMENT AND GENERAL STORES.

Telautographs, shifting signs, revolving show cases, sign flashers, electric fountains, moving window displays, escalators, elevators, dumb waiters, cash carriers, hoists, air compressors.

DRUG STORES AND SODA FOUNTAINS.

Milk shakers, grinders, ice crushers, drug mills, ice and refrigerating machines, ice cream freezers, fans, carbonating apparatus.

ELECTROTYPERS.

Routers, planers, circular saws, brush wheels, drills, fans.

FOUNDRIES.

Steel saws, grinders, tumblers, portable drills, hoists, cranes, blowers.

GAS AND STEAM FITTERS.

Lathes, thread cutters, pipe cutters, hoists, punches, blowers.

GRAIN ELEVATORS AND FLOUR MILLS.

Cleaners, flour packers, corn shellers, feed grinders, rolls, elevators, conveyors, power shovels, exhaust fans, air compressors for automatic sprinkler systems.

HARNESS AND SADDLE SHOPS.

Sewing machines, skivers, buffers, rollers.

HAT MANUFACTURERS.

Hat brushers, hat blockers, hat burnishers.

HOTELS.

Telautographs, automatic pianos, elevators, dumb waiters, carbonating apparatus, knife grinders, silver buffers, dish washers, pitcher cleaners, bread crumbers, potato parers, meat choppers, dough mixers, laundry machinery, ice cream freezers, ice and refrigerating machinery, fans, vacuum cleaning outfits, carpet sweepers.

JEWELERS AND OPTICIANS.

Drills, grinding and buffing lathes, ventilating fans.

MACHINE SHOPS.

Machine tools and all appliances requiring power.

MEAT MARKETS.

Meat grinders, meat cutters and choppers, ice and refrigerating machines.

OFFICE BUILDINGS.

Passenger and freight elevators, pumps, heating and ventilating apparatus, vacuum cleaning apparatus, fire pumps.

PAPER BOX MANUFACTURERS.

Presses, dies, automatic box machines, paper cutters, hoists.

PIPE MANUFACTURERS.

Automatic oiling devices, thread cutters, pipe cutters, pipe drawers.

PLUMBERS' AND TIN SHOPS.

Hoists, wire and plate straighteners, punches and presses, buffers and grinders, thread cutters, pipe cutters, drills.

PRINTING AND PUBLISHING PLANTS.

Printing presses, neostyles, addressing machines, paper cutters, ruling machines, linotype and monotype machines, perforators, stitching machines, gumming machines, folding and stapling presses, routers, elevators.

RESIDENCES.

Automatic pianos, dumb waiters, automatic elevators, horse clippers and groomers, tire pumps, sewing machines, polishing and grinding machines, ice and refrigerating machines, vacuum cleaners, carpet sweepers, lawn mowers, washing and ironing machines.

RESTAURANTS.

Potato parers, bread crumbers, coffee grinders, dough mixers, meat choppers, pitcher cleaners, dish washers, laundry machines, ice cream freezers, knife sharpeners, automatic pianos, ice and refrigerating apparatus, dumb waiters, elevators, ventilating fans.

SALOONS.

Sign flashers, ice and refrigerating machines, automatic pianos, beer pumps, passenger, freight and dumb elevators.

SHIRT AND OVERALL MANUFACTURERS.

Sewing machines, pattern cutters, cloth cutters, fans.

SILK MILLS.

Fan for drying gloves, brushing mills, combers, beamers, warpers, spoolers, looms.

THEATERS AND CONCERT HALLS.

Curtain and stage drops, scene lifting devices.

WEAVERS AND KNIT GOODS MANUFACTURERS.

Knitting machines, looms, braiders, buttonhole machines, sewing machines, hoists.

The foregoing lists, while fairly complete, may be added to materially and should be added to as fast as possible. In addition to the lists it is advisable to have a filing cabinet, with a folder for each industry, and as fast as data are collected relative to electric drive they should be filed under respective heads. Clippings from technical papers descriptive of motor installations are a fruitful source of information. It is surprising how fast data can be collected and an information bureau for private use will prove of great value for the future work of the new business department.

The modern hotel building offers an excellent example of electric drive for many purposes and a description of the motor equipment of a prominent hotel in the East, recently inspected by the writer, will illustrate the many possibilities in this branch of business. In hotel buildings cleanliness and noiseless operation are absolutely essential to the comfort of guests, and the electric motor is ideal for this purpose, as it may be placed in any location that convenience dictates.

The hotel in question has 400 rooms and serves meals to an average of 1500 people daily. There are over 50 motors operating appliances in the various departments, including a complete modern laundry in an adjoining building.

Sanitation has been carefully looked after, the building being equipped with a complete motor-driven ventilating system. The rooms and halls are cleaned by a vacuum cleaner outfit operated by a 7½-hp direct-current motor. The outfit has a capacity of six sweepers operating at one time and pipe lines lead from the vacuum pump and tanks in the basement to all parts of the hotel. These cleaners are not only indispensable to health, but greatly reduce the expense of cleaning.

The kitchen is provided with a vegetable peeler, having a rated capacity of 400 bushels of potatoes a day, driven by a 1-hp motor; a meat chopper driven by a 1-hp motor, and a dish washer, ice-cream freezer and small grindstone group-driven by a 5-hp motor.

The laundry occupies two floors and the basement of an adjoining building. In the basement are located seven washers driven by a 15-hp motor from a line shaft. The diameter of

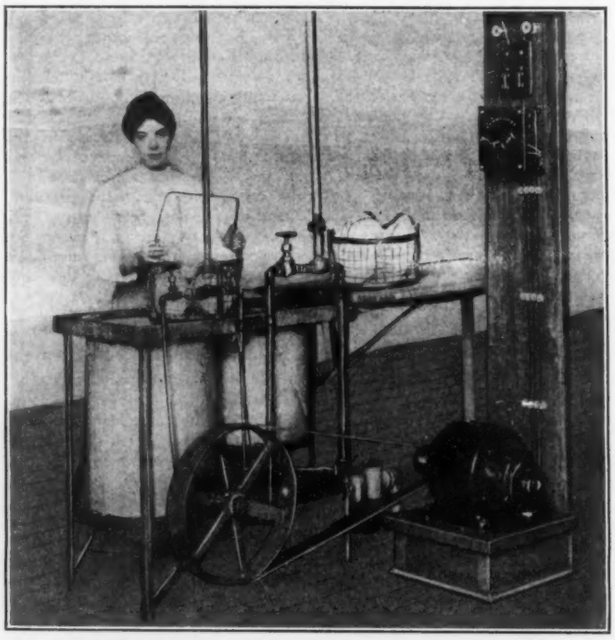


FIG. 4.—SMALL MOTOR-DRIVEN DISH WASHER.

the inside cylinder of the washers is 32 in. and the length 58 in. In addition to the washers there are three extractors each driven by a 1½-hp motor. The motors are mounted on the base of the extractors and are belted to a pulley on the spindle. There are two large mangles located on the first floor, one with five hot rolls and one with seven hot rolls, each driven by a 3-hp motor by means of gearing. The capacity of the mangles is approximately 60 ft. per minute and they are used for large pieces. On the second floor is located the equipment of small machines including a collar and cuff ironer, with a capacity of 600 pieces per hour, driven by a ¾-hp motor; sleeve ironer driven by ¼-hp motor; mangle for small work driven by a 1-hp motor and two drying rooms, belt-driven from a 2-hp motor.

Electric Signs at Birmingham, Ala.

An excellent electric sign development has lately taken place in the territory of the Birmingham Railway, Light & Power Company. In the Birmingham district alone, which has a population of about 50,000 inhabitants, there were 160 electric signs in service at the first of the year. The largest sign is used by a prominent clothing house, and contains 366 Edison sign lamps. The company operates about 50 signs on a meter basis, the balance being on a flat rate.

The flat rate varies from 20 cents to 30 cents per month per

lamp; this includes the rental of the sign, lamp renewals, repairs, cleaning and painting. In this way the signs are kept in good electrical and mechanical condition, and are always working at the point of maximum effectiveness. The lamps burn from dusk until 11 p. m. week days and until midnight on Saturdays. One of the most interesting results from the use of display illumination has been in connection with Third Avenue, between Nineteenth and Twentieth Streets. This block is located in the heart of the business district, but for some reason the street was never popular until the abutting merchants decided to light it every night by festoons of incandescents at their own expense. Fourteen arches span the street for a distance of 500 ft., and a total of 640 8-cp lamps are in service. The brilliancy of this illumination has completely altered the character of the street in respect to popular favor.

The Steam Laundry—A Promising Field for the Sale of Electrical Energy.

Possibly the proprietors of steam laundries are more difficult to convince than others that the use of electric motors and central-station service will be less expensive than older means of power supply, because they actually require a steam boiler in their work all the year. Their argument is along the lines that the added cost of operating a steam engine under these conditions is almost negligible.

It may be of interest to note the following relative costs of the two methods, based on actual figures taken from the records of an electrically equipped laundry that has been operating satisfactorily for the last year:

WITH STEAM ENGINE.

Item.	Per Month.
Coal	$60.00
Labor	62.50
Water	16.00
Total	$138.50

WITH ELECTRIC MOTORS.

Item.	Per Month.
Coal	$25.00
Labor	12.50
Water	11.00
Electric current	45.00
Total	$93.50

These figures show a saving, over steam drive, of $45 per month, or $540 per year. This is equal to one year's interest at 36 per cent on the investment required. In addition to covering the interest on the investment at 6 per cent, the saving will return the entire cost of the change from steam to electric drive in three years and four months.

The maintenance cost of the electric system amounts to practically nothing, while with the steam engine repairs are frequent and expensive, due not only to their actual cost but also to the value of time lost during repairs, as all work must be suspended when repairs are in progress. The laundry herein referred to has in service a total of 16 direct-current motors ranging in size from ¼ to 5 hp.

The three accompanying illustrations show the typical methods used—suspending the motors from the ceiling and employing only light countershafting, and as little of that as possible.

If a prospective customer can be shown as favorable a proposition as the above, based on his present power cost and an estimate of electric power, he can no longer say, "Does it pay?" but "Can I afford to do without the electric motor?"

Another remarkable feature of the aid that electricity affords in this line of work is in connection with the equipment of laundries with electric flat-irons. During the summer months, especially in sections where the humidity is very high, the electric flat-iron has proven such a remarkable relief to the workers that the output has been doubled over former records. The quality of the work has been bettered at a time when prostrations among the employees is not uncommon, and when rush or overtime work is ordinarily out of the question, however much the proprietor desires it during the hot, dusty season, when the shirtwaist rules supreme.

The Philadelphia Hospital Laundry affords a good example of the adaptability of electricity to laundry work. The building is a one-story substantial stone structure, with one large room for general laundry work and a smaller boiler room. Steam at both high and low pressure is supplied for general laundry purposes by water-tube boilers. A single 50-hp motor drives line shafting to which the mangles, washers, centrifugal extractors, etc., are belt-connected. The iron used is the standard 6-lb. 110-volt cartridge unit type. There are 48 of these irons installed, and an aggregate of 97,000 pieces are ironed each month. It has been found that from 20 to 30 per cent more work can be done with the electric irons than was formerly done with the same number of stove-heated irons.

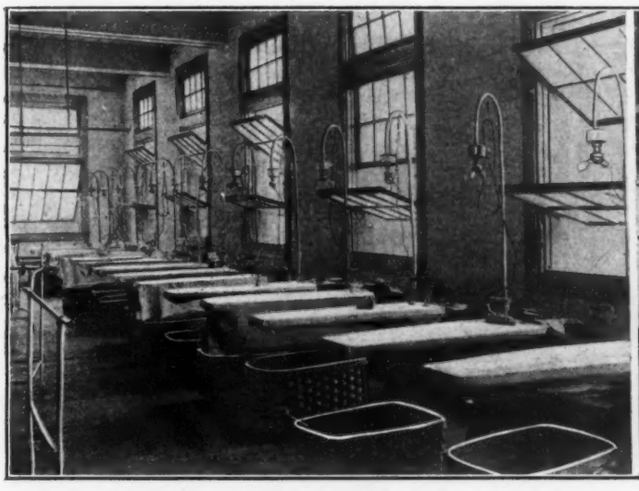


FIG. 1.—GUTHMAN'S LAUNDRY, ATLANTA, GA.

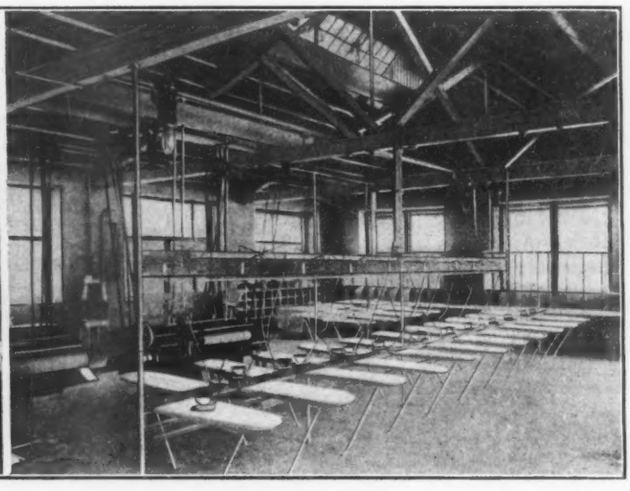


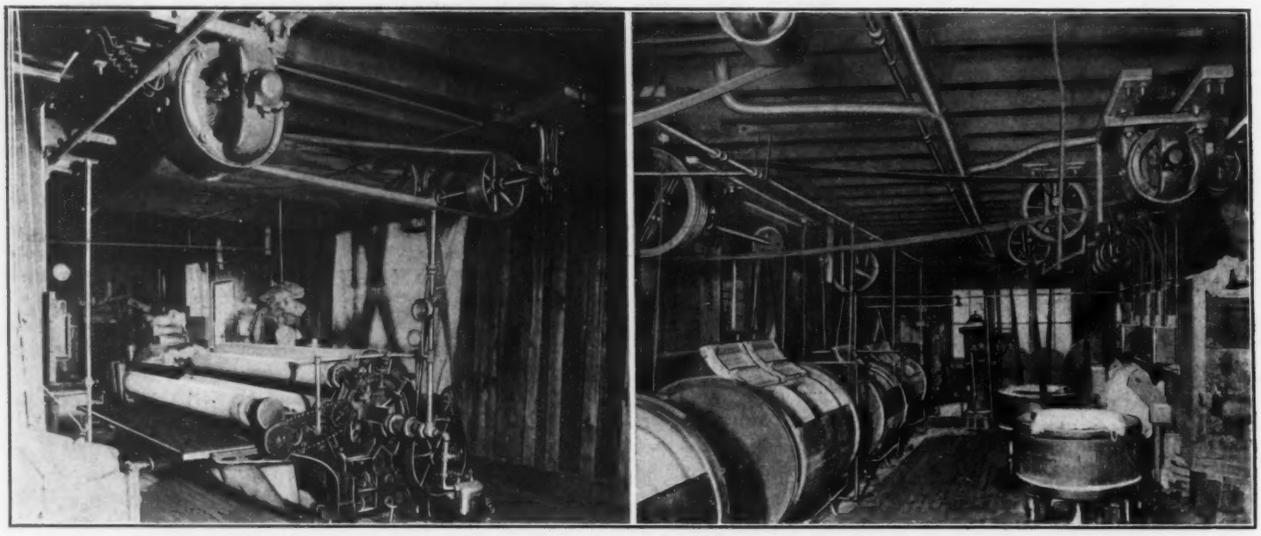
FIG. 2.—FLAT IRONS IN PHILADELPHIA HOSPITAL LAUNDRY.

Another excellent example of a modern establishment in which electricity plays an important part is the Guthman Steam Laundry, in Atlanta, Ga., which was equipped with electric drive some few years ago by the General Electric Company. In this model laundry, which rivals in equipment any similar establishment in the larger Northern cities, the majority of the machines are direct-driven by individual motors. Each mangle is driven by a 5-hp motor, while the ironing machines and starching apparatus are driven by smaller individual motors. The large dry houses are each provided with motor-driven fans for circulating the hot air. Two 15-hp motors drive separate line shafting from which are driven the washing machines and centrifugals, group drive for this apparatus being found advisable from an engineering standpoint. An electric elevator carries the work directly from the wagons to the sorting room on the top floor.

In this laundry there are installed thirty 6-lb. and ten 3-lb.

electric flat-irons of the well-known cartridge unit type. These irons superseded the same number of cumbersome and inefficient gas-heated irons.

The true verdict of the successful operation of a device is to be obtained from its commercial use. Several of the operatives were asked, independently, their opinions of the electric irons as compared with the gas-heated irons, and the invariable reply was vastly in favor of the electric iron. It has been demonstrated beyond a doubt at the Guthman Laundry that with the use of electric irons 30 per cent more work can be done by each operator each working day.



FIGS. 3 AND 4.—LAUNDRY MANGLE AND WASHING MACHINE AND EXTRACTOR.

The steam laundry is a lucrative field for the promotion of the use of electric motors for power purposes; and the fact that many of our large metropolitan central stations have connected a number of laundries to their circuits for power, as well as lights, is evidence showing that the practicability and business economy of motor drives in laundry work is now being recognized.

Decorative Street Lighting.

Through the enterprise of the Fillmore Street Improvement Association, of San Francisco, an innovation in street lighting has recently been developed. Some time ago it was decided to illuminate Fillmore Street from Fulton to Sacramento Streets, a distance of over a mile, in as decorative and effective a manner as possible. All available sources of illumination were considered, including the newer types of flaming arc lamps, and it was finally decided that the ordinary carbon-filament incandescent lamp produced the greatest decorative effect, and could be placed in a way that would be festive and pleasing to the eye. It was agreed that the different types of arc lamps gave out a more brilliant light, but that this intensely brilliant light would, owing to the contraction of the iris of the eye, detract from the illumination in the show windows.

The design finally agreed upon consisted of a double span of curved trusses, as shown in the accompanying illustrations, erected across the four corners of each street crossing. This truss work is built up of 5-in. channel iron, with 1½-in. x ¼-in. lattice work, the four arms being fastened at the apex by a swivel joint. Each arch weighs about two tons and the maximum span from pole to pole is 82 ft. Extra heavy steel poles set in concrete support the arches.

Much difficulty was experienced in the erection of the arches, owing to the maze of overhead wires. In many places there was not a space 10-ft. square through which to work the arch. Although the street car system was in operation at all times, the work was carried on without a single accident.

There are 130 16-cp incandescent lamps on each arch. Weather-proof sign sockets are used and the wires are effectually concealed in a trough formed by fastening a plate over the flanges of the lower channel. A three-pole knife switch and fuse cut-out are placed in a cast-iron box fastened to a pole of each arch. The arch is painted white.

The lamps were first switched into circuit on Thanksgiving eve, and the arches have been illuminated each evening since that time without interruption. The results have proved very satisfactory, and the merchants are elated over the increased attractiveness of the street. The arches being placed on the street crossings, the illumination is visible for a distance of over 10 blocks either way on the cross streets.

This is probably the most elaborate system of permanent arch lighting thus far tried.

FIG. 1.—FILLMORE STREET BY DAY.

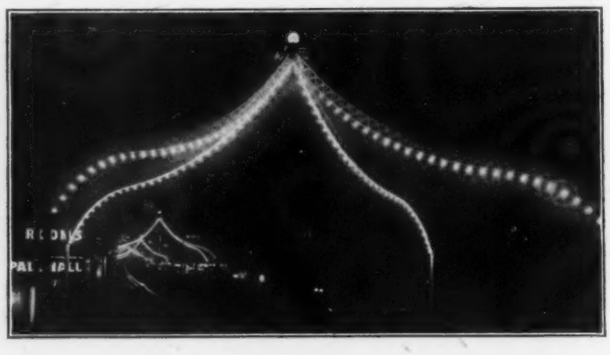


FIG. 2.—FILLMORE STREET BY NIGHT.

The work of designing and erecting the arches was carried forward by the Butte Engineering & Electric Company at a cost of $10,000.

Lancaster (Pa.) Central-Station Display Room.

The widely-felt hard times and business depression have apparently had no discouraging effect on the progressive business methods of the Edison Electric Illuminating Company and the

FIG. 1.—LANCASTER ELECTRIC DISPLAY.

Lancaster Gas Light & Fuel Company, of Lancaster City, which have recently opened a very attractive and complete electrical and gas display room. The accompanying illustrations give a

FIG. 2.—SHOW WINDOW DISPLAY, LANCASTER.

general idea of the attractive exterior and show the tasteful arrangement of the exhibits.

This departure in connection with the recently organized "new business" department is attracting much attention and interest is steadily increasing. Besides immediate results, as indicated in appliance sales, the plan is in addition aiding the electric-gas publicity work in a degree fully warranting the expenditure. Much of the new business is traceable to this medium, and, in brief, the investment is considered gilt-edge. Mr. C. Edgar Titzel is the capable and wide-awake general manager of the above companies, and Mr. H. J. Von Nieda is superintendent of the "new business" department.

The New System of Rates at St. Louis.

The Union Electric Light & Power Company, of St. Louis, has recently put in force a new system of rates which differs considerably from the typical systems in use by American central-station companies. A recent bulletin of the company explains these rates at length in a manner calculated to be understood by the general public. In a letter addressed to the public at the beginning of this bulletin, Mr. W. V. N. Powelson, president and general manager, calls attention to the general principles underlying these rates. The value of the service rendered to any individual must, as far as practicable, be based on the cost to serve him, and not on the average cost to serve the entire body of consumers; and as the cost per kw-hour varies greatly with different classes of service, so should the price per kw-hour in justice to the several users vary greatly to different consumers.

CONNECTED LOAD IN EQUIVALENT 16 C. P. LAMPS	MINIMUM MONTHLY GUARANTEE FOR EQUIVALENT 16 C. P. LAMP CONNECTED, IN CENTS.																
	10	15	20	25	30	35	40	42½	45	47½	50	52½	55	57½	60	62½	65
UNDER 100	12	11¼	11¼	11¼	11	10¾	10½	10¼	10	9¾	9½	9¼	9	8¾	8½	8¼	8
From 100 to 150	11¼	11¼	11¼	11	10¾	10¾	10¼	10	9¾	9½	9¼	9	8¾	8¾	8¼	8	7¾
" 150 " 200	11¼	11¼	11	10¾	10¾	10¾	10	9¾	9½	9¼	9	8¾	8¾	8¼	8	7¾	7½
" 200 " 250	11¼	11	10¾	10¾	10¾	10	9¾	9¾	9¼	9	8¾	8½	8¼	8	7¾	7½	7¼
" 250 " 300	11	10¾	10¾	10¾	10	9¾	9½	9¼	9	8¾	8½	8¼	8	7½	7¼	7	
" 300 " 350	10¾	10¾	10¾	10	9¾	9½	9¼	9	8¾	8½	8¼	8	7¾	7½	7¼	7	6¾
" 350 " 400	10½	10¾	10	9¾	9½	9¼	9	8¾	8½	8¼	8	7¾	7½	7¼	7	6¾	6½
" 400 " 450	10¼	10	9¾	9½	9¼	9	8¾	8½	8¼	8	7¾	7½	7¼	7	6¾	6½	6¼
" 450 " 500	10	9¾	9½	9¼	9	8¾	8½	8¼	8	7¾	7½	7¼	7	6¾	6½	6¼	6
" 500 " 550	9¾	9½	9¼	9	8¾	8½	8¼	8	7¾	7½	7¼	7	6¾	6½	6¼	6	5.9
" 550 " 600	9½	9¼	9	8¾	8½	8¼	8	7¾	7½	7¼	7	6¾	6½	6¼	6	5.9	5.8
" 600 " 650	9¼	9	8¾	8½	8¼	8	7¾	7½	7¼	7	6¾	6½	6¼	6	5.9	5.8	5.7
" 650 " 700	9	8¾	8½	8¼	8	7¾	7½	7¼	7	6¾	6½	6¼	6	5.9	5.8	5.7	5.6
" 700 " 800	8¾	8½	8¼	8	7¾	7½	7¼	7	6¾	6½	6¼	6	5.9	5.8	5.7	5.6	5.5
" 800 " 900	8½	8¼	8	7¾	7½	7¼	7	6¾	6½	6¼	6	5.9	5.8	5.7	5.6	5.5	
" 900 " 1000	8½	8	7¾	7½	7¼	7	6½	6¼	6¼	6	5.9	5.8	5.7	5.6	5.5	5.4	
" 1000 " 1250	8	7¾	7¼	7¼	7	6¾	6½	6¼	6	5.9	5.8	5.7	5.6	5.5	5.4		
" 1250 " 1500	7¼	7½	7¼	7	6¼	6½	6¼	6	5.9	5.8	5.7	5.6	5.5	5.4	5.3		
" 1500 " 1750	7½	7¼	7	6¾	6½	6¼	6	5.9	5.8	5.7	5.6	5.5	5.4	5.3			
" 1750 " 2000	7¼	7	6¼	6½	6¼	6	5.9	5.8	5.7	5.6	5.5	5.4	5.3	5.2			
" 2000 " 2250	7	6¼	6½	6¼	6	5.9	5.8	5.7	5.6	5.5	5.4	5.3	5.2				
" 2250 " 2500	6¾	6½	6¼	6	5.9	5.8	5.7	5.6	5.5	5.4	5.3	5.2	5.1				
" 2500 " 2750	6½	6¼	6	5.9	5.8	5.7	5.6	5.5	5.4	5.3	5.2	5.1					
" 2750 " 3000	6¼	6	5.9	5.8	5.7	5.6	5.5	5.4	5.3	5.2	5.1	5					
3000 & Over	6	5.9	5.8	5.7	5.6	5.5	5.4	5.3	5.2	5.1	5						

RATES IN CENTS PER KILOWATT HOUR.

In the explanation of the rate system which follows Mr. Powelson's letter, it is explained that in the past the company has been compelled to recognize the force of the argument of the customer who maintained that he was entitled to a lower average rate if he guaranteed $5 per horse-power per month than his neighbor who would guarantee only $1 per horse-power per month. This necessitated "special" contracts. It has happened that a customer, without knowing anything about the special considerations which entitled his neighbor to a lower rate, demanded that rate for himself, although the character of his use of the service would not justify the same rate. The customer paying a higher rate than his neighbor sometimes felt that he was being discriminated against, although the character of his load was entirely different. On account of the existence of this feeling, the company explains that it has felt it necessary to codify the system of rates adopted. Under this system the service is divided into a very much larger number of classes than has ever before been attempted. Every consumer in the same class will get the same rate, without regard to his personality and importance in the community.

The fundamental principle of the St. Louis system of rates is that the customer's rate is based on the minimum monthly guarantee he is willing to make per horse-power or per 50-watt lamp connected. The rate is also lower the larger the connected load. For example, the customer having less than 100 lamps pays 12 cents per kw-hour if he guarantees only 10 cents per month per lamp. If he guarantees 65 cents per month per lamp he need pay only 8 cents per kw-hour. Between the 10-cent and 65-cent guarantees there are 15 intermediate steps. For example, by guaranteeing 45 cents per month per lamp, the customer gets a rate of 10 cents per kw-hour. The rate is also made lower as the number of connected lamps increases. For example, a customer guaranteeing 10 cents per month per lamp and having less than 100 lamps pays 12 cents per kw-hour. This is reduced by steps until for 3000 lamps or over the rate is 6 cents per kw-hour, with a 10-cent per lamp guarantee. For the 45-cent per lamp guarantee the customer with less than 100 lamps pays 10 cents per kw-hour, while the customer with 3000 lamps pays 5.2 cents per kw-hour.

All these rates are subject to further discounts based on hours' use and quantity. The discount made according to the equivalent daily hours' use of the entire connected load starts with a 6 per cent discount for a kw-hour consumption equivalent to one hour's use per day of the connected load, rising by steps to 25 per cent discount for a kw-hour consumption equivalent to 18 hours' use per day of the connected load. There is also in addition to this a discount based on the amount of the bill, which is from 5 per cent on bills of under $10 to 56 per cent on bills of over $9,000 per month. The power rates are on the same plan. A 1-hp motor customer pays 10 cents per kw-hour if he guarantees $1 per month per horse-power. If he guarantees $7.50 per month per horse-power he pays 5 cents per kw-hour. There are a number of intermediate steps between the 10- and 5-cent rate, depending on monthly guarantee, just as in the case of the lighting rate. The rate also depends on horse-power connected. Under the $1 per horse-power per month guarantee the customer with over 500 horse-power gets a 5½-cent rate. If the same customer guarantees $2 per month per horse-power the rate is 4½ cents. In order to aid the reader in the better understanding of these rates and the way they are presented, a table showing the standard lighting rates is here reproduced from the company's bulletin. The bulletin itself is a very complete document, giving all of the contract forms of the company, examples in which the different lighting rates are applied to specific cases and a number of tables which are of assistance to solicitors and customers in determining the monthly guarantee which would be likely to secure them the cheapest service.

The rates for heating and cooking circuits in residences are 12 cents per kw-hour for a minimum monthly guarantee of $2; 11 cents for a $3 guarantee; 10 cents for a $4 guarantee; 9 cents for a $5 guarantee; 8 cents for a $7.50 guarantee; 7½ cents for a $10 guarantee, and 7 cents for a $15 guarantee. There is a discount according to quantity on these cooking rates, which begins with 5 per cent on bills of $5 or under and increases 1 per cent for each $1 increase in bill up to $15, where there is a 15 per cent discount. For bills over $25 there is a 20 per cent discount.

Marion (Ind.) Central-Station Enterprise.

The Marion, Ind., *News-Tribune* dated Feb. 20 is a special electrical issue, containing eight pages devoted entirely to electrical matters. The object of issuing the special edition is stated to be to call attention to "the best lighted city in the United States, a city that has unlimited power for manufacturing purposes, and whose industries utilize, almost exclusively, electricity for light and power." The numerous illustrations included show several examples of store exterior lighting and about a score of factories which are operated electrically. Portraits and biographical sketches appear of Mr. S. H. Smith, superintendent of the Marion Light & Heating Company, and Mr. E. Hollingsworth, manager of the "new business" department. The company is represented by a full-page advertisement, attractive in design and forceful in concise presentation of convincing facts. Although Marion has a population of less than 25,000, the company supplies current for the equivalent of 57,600 16-cp lamps; over 800 families use electric irons and a number of consumers do all of their cooking by electricity.

Letter to the Editors.

Chimneyless House.

To the Editors of Electrical World:

Sirs:—Recent descriptions of houses without chimneys recall to my memory the kirk built by my great-great-grandfather, Philipse, at Tarrytown, near the Pocantico, and old St. Peter's Church, near Peekskill, both without chimneys; those using these old buildings had to keep from freezing with foot stoves. I like chimneys straight as possible in all rooms for ventilation, even where steam, hot water or electricity are used for heating. By the use of cords and pulleys, many of the electric lights in 21 East Twenty-sixth Street can be moved 60 ft. from the wall rosettes and will remain stationary when simply laid over an ordinary hook, and they have worked successfully ever since electricity was put in, perhaps 20 years ago.

New York City. Cortlandt de P. Field.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Testing Large Induction Motors.—N. Pensabne-Perez.—An illustrated description of a complete Hopkinson test as applied to four large induction motors at a British works. The author first gives a complete vector diagram for induction motors with Hopkinson connections. When two induction motors having pulleys of different diameters are belted together, and their primaries connected to the same supply lines, they start up as ordinary induction motors until the machine which runs faster, reaching synchronism, becomes a generator and sends energy back to the other machine, which acts as a motor. The equilibrium will be established when the torques of the two machines are inversely proportional to their speeds. From the vector diagram it is seen that while in the induction motor the primary copper resistance and the iron losses increase the value of the power factor, the opposite is true for the synchronous generator; therefore, an induction motor working as a generator with a certain current input has a power factor lower than when working as a motor and taking the same current. The current supplied by the main is the vectorial sum of the currents taken by the two machines; it is of about the same magnitude as the motor current. This constitutes the weak point of this kind of test, because it will be necessary not only to supply the excess of power for the losses of the two machines, but also to have the alternator supplying the energy much larger than the motor to be tested; in fact, it must supply about the full kilowatt input at a very low power factor. The method of carrying out the test is described and formulas for determining the different losses with numerical applications are given.—Lond. *Elec. Rev.*, Jan. 24.

Leakage of Induction Motors.—R. Goldschmidt.—This long serial has now been concluded. A brief summary of the whole is as follows: Some important relations derived from the circle diagram are given in the form of tables, after which the

author considers the calculation of the no-load current of polyphase and single-phase induction motors with half-closed and open slots. The different classes of leakage are then dealt with, slot leakage, zig-zag leakage and leakage of the coil ends. Curves are given for the leakage with different slot dimensions and also tables showing the effect of the coil ends with different classes of windings. The calculation of the leakage factor, with polyphase and single-phase motors, and the influence on it of the different forms of winding are finally shown.—Lond. *Elec.*, Nov. 29, Dec. 20, Jan. 3, 17, Feb. 7.

Reduction of Slot Openings.—R. GOLDSCHMIDT.—An illustrated English translation of his recent German paper on the method of reducing slot openings by means of iron bridge pieces.—Lond. *Elec. Rev.*, Feb. 7.

Lamps and Lighting.

Transformers for Metallic-Filament Lamps.—F. V. O'HANLON.—An article pointing out that it pays to use low-voltage metallic-filament lamps even on high-voltage circuits with the aid of small transformers. The author claims that such transformers can be turned out quite well by anyone having a lathe and the usual tools. The advantages of a one to one autotransformer are explained, and the following problem is solved. It is required to design an autotransformer to supply energy to 35 osram lamps of 32 candle-power at 100 volts, from a primary voltage of 200, the frequency being 50. For the iron core "stalloy" (a special transformer iron of English make) stampings 0.01 in. thick are used, the dimensions of the core being as shown in Fig. 1. The windings are placed on the two longer

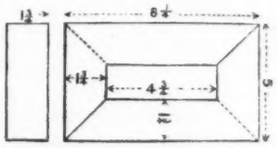


FIG. 1.—DIAGRAM OF DIMENSIONS OF TRANSFORMER CORE.

limbs, and it is found that 532 turns of No. 14 gage wire are to be used. They are wound in six layers, and have a total length of 419 ft. Two other numerical examples are also solved, and it is pointed out that not only core-type transformers, but also shell-type transformers may be used, especially in cases of three-wire balancing or distribution.—Lond. *Elec. Rev.*, Jan. 31.

Incandescent Lamp.—A note on an arrangement due to Gelnhausen, in which the lamp is exhausted at the foot, instead of as is usual at the top. Connection to the vacuum pump is made by a glass tube which passes to the interior of the lamp. The metal cap fits tightly round the tube, and when the air has been exhausted, this tube is sealed off so that an air-tight joint is obtained. It is claimed that the arrangement is less easily damaged than that usually employed.—Lond. *Elec.*, Jan. 31.

Osram Lamp.—The German Welsbach Company now advertises osram lamps consuming one watt per hefner candle-power and adapted for use in any position for connection in parallel in sizes of 25, 32 and 50 hefner candles, at from 100 to 130 volts, and 40 to 50 hefner candles at from 200 to 250 volts. On the other hand, the 100-cp osram lamps, as well as osram lamps for connection in series, are to be used for the present in vertical position only.—*Elek. Anz.*, Feb. 6.

Power.

Electric Drive of a Large Rolling Mill.—W. A. DICK.—An illustrated description of the electric equipment of a large rolling mill at the plant of the Illinois Steel Company. The mill is a 30-in. universal reversible plate mill, with two high rolls, used for rolling plates and bars. In general, the cycle of operations in rolling a typical piece includes 13 passes through the rolls, the speed of the rolls for the initial pass being 40 r.p.m. with a gradual increase in speed for each succeeding pass up to the final, where a speed of 140 r.p.m. is required. The torque required of a driving motor was approximately 300,000 lb.-ft. for the initial pass. The torque increases slightly for the next two passes, and then gradually decreases, the final pass requiring about 60,000 lb.-ft. The horse-power required is about 2300 for the first pass, and gradually increases up to the seventh pass, where it is approximately 3500. From this point it gradually decreases until it is about 1500. The average horse-power for the entire cycle is 1300. A complete cycle, the time to roll a typical piece, is about 80 seconds. The apparatus consists of a motor for driving the rolls of a mill, a motor-generator or equalizer set with a large fly-wheel for supplying energy to the motor, and a system of control for operating the outfit. Owing to the necessity of very rapid reversals, the motor is built for direct current, and is directly coupled to the rolls. Its field is separately excited, and it is operated from the generator of the equalizer set and by a limited amount of field control. Its speed is varied at will over a wide range. It also operates as a generator in dynamic braking when stopping. The equalizer set, which supplies the necessary energy to the mill motor, consists of a direct-current generator, an alternating-current motor and a fly-wheel. The direct-current generator is separately excited, and its voltage is variable. It also acts at times as a motor, receiving energy from the motor of the rolls when the latter is braking. The alternating-current motor receives its energy from a regular alternating-current supply system. The fly-wheel serves the purpose of a storage reservoir, receiving energy from the alternating-current motor at times of light load on the mill from the mill motor when that is braking and giving out energy at times of heavy load on the mill motor. The controller regulates the alternating-current motor and controls the speed and direction of rotation of the mill motor. The different machines are described in detail and illustrated. The various advantages of electric drive, all of which result in a material decrease in the cost of production, are pointed out. —*Electric Journal*, February.

Thury System for Rolling Mills.—An illustrated article on the application of the direct-current series system of Thury to rolling mills and winding engines. In this system the prime movers, fly-wheels (which are necessary to take off the variations of load) and direct-current generators are all located in the power house. "The Thury system accommodates itself to all speeds, and as a result the fly-wheel becomes an accumulator of greater value and higher efficiency in the Thury than it does in any other system." As is well known, the system employs a constant current at a voltage depending on the load. The generators and motors are series wound, and are controlled by brush movement alone. The only plant outside of the generating station consists of the actual motors themselves. No fly-wheel sets have to be placed adjacent to the mills or winders. The advantages that such a system would have are pointed out. —Lond. *Elec. Rev.*, Jan. 24.

Electric Welding Plant.—An illustrated description of the electric winding plant at Axwell Park Colliery, which, although of small size, as compared with most main-shaft winding engines, is a complete example of the Ilgner system with fly-wheel-converter.—Lond. *Elec. Eng'ing*, Jan. 30.

Electric Driving for Textile Mills.—E. L. HILL.—An article discussing the advantages of electric driving for textile mills and the question whether preference should be given to group drive or individual drive in different cases. The group-drive is by far the most common, and is usually the most economical on account of its low first cost and high efficiency. The individual-drive is specially suitable for weaving sheds. Group driving is usually the best in spinning mills. Mules should always be driven on the group system. Ring and doubling frames, on the other hand, can often be advantageously driven by separate motors, although the investment cost will be higher. It is stated that rapid progress in the electric driving of textile mills is now being made in England, and by midsummer of this year almost 6 per cent of the total spindles in Lancashire will be electrically driven.—Lond. *Elec. Eng'ing*, Jan. 30.

Electric Motors in Textile Mills.—J. SHAW.—A paper read before the Dundee Inst. of Eng. The author discusses the advantages of the electric driving of textile mills, and advocates the obtaining of the necessary energy from a supply company rather than installing an independent plant.—Lond. *Elec.*, Feb. 7.

Water for Economical Steam Generation.—J. C. W. GRETH.—The first part of an article in which the author gives figures

as to the savings which are accomplished in actual water-softening plants.—*Eng'ing Mag.*, February.

Traction.

Electric Traction in Great Britain.—The yearly statistical tables on electric tramways and railways in Great Britain. The total mileage of tramway track, as given in these tables, is now 3651, compared with 3362 miles last year; that is, an increase of a little under 9 per cent. This percentage increase is, therefore, less than the 10½ per cent recorded a year ago, and the 10 per cent in 1905, although the mileage increase varies very little, and thus indicates a steady development. Of the new tramways which have been opened, two have been equipped on the Dolter surface-contact system, while the G. B. surface-contact system is being adopted on a line in London. Some information is given of the lifeguards and car meters in use on the various tramways. Although such meters are not at present in general use, there is evidently a desire on the part of tramway managers to adopt some means of ascertaining those cars on which the energy consumption is excessive. With respect to the electrification of railways, the most important work has been the equipping of short sections of the London, Brighton & South Coast Railway and the Midland Railway on the single-phase overhead system, but, apparently, there is very little likelihood of any further important electrification in the immediate future. —Lond. *Elec.*, Jan. 31.

San Francisco.—A. H. Halloran.—The first parts of a fully illustrated article on the rehabilitation of San Francisco's street railway systems.—*Jour. of Elec. Power & Gas.*, Feb. 8, 15.

Tramway Accessories.—An article describing new constructions of a trolley-tension indicator, of a rail cleaner, and of a trolley-standard earthing-device.—Lond. *Elec.*, Jan. 31.

Installations, Systems and Appliances.

Great Britain.—Tables giving details of British stations with no tramway load, stations taking supply in bulk, and stations having combined lighting and traction loads. The following is a summary of the connections in kilowatts to municipal and companied stations in London and the provinces:

	Municipal.	Company.	Total.
London	80,062	214,762	294,824
Provinces	743,488	211,754	955,242
Total	823,550	426,516	1,250,066

Out of the total of 1,250,066 kw, there are 491,741 kw connected to direct-current stations, 171,922 to alternating-current stations, and 586,403 kw to combined direct-current and alternating-current stations. There has been a steady increase in connections over last year, which is most marked in the case of municipally owned stations supplying both alternating current and direct current, so that these have now the largest number of connections.—Lond. *Elec.*, Jan. 24.

Coburg.—O. Ely.—The conclusion of his illustrated article on the electric station in Coburg. This is given as an example that small electricity works may give good financial results if properly designed. The results have been so satisfactory that the municipality intends to operate the station itself in future.—*Elek. Zeit.*, Jan. 30.

Far East.—A table giving statistical data on 35 electric lighting and power stations in the Far East (Japan, China and the Philippines). The table gives detailed information on equipment, rates of charging, etc.—Lond. *Elec. Rev.*, Feb. 7.

A Field Reversal.—C. W. Kinney.—An article referring to a peculiar field reversal which occurred in a power plant consisting of a 440-volt, 150-kw, belted three-phase generator, with a 6-kw, four-pole, 125-volt, belted exciter. A few minutes before "shutting-down time" the alternator lost its field. A hurried examination showed that the negative exciter lead was broken at the brush-holder, also that three of the pole pieces were north poles, and one south. After the broken lead had been repaired, a short-circuit test with a telephone receiver showed the circuit between the two armatures clear. The machines were then started up, but the exciter "picked up" voltage in the wrong direction. The only direct-current apparatus available was a couple of almost exhausted dry batteries. These were applied to the series field circuit of the exciter. They would reverse the field magnetism in the air-gap, but as soon as they were disconnected the residual field in the core still showed the wrong polarity. The batteries were then applied to the shunt field circuit. The field in the air-gap was apparently neutral, while the batteries were attached. This suggested a possible solution of the trouble. The batteries were connected in the shunt-field circuit, and then the machine was started with all the resistance in the rheostat cut out. After a few seconds the machine began to "pick up" voltage in the right direction and was then ready for use. Fig. 2 shows the cause of the field reversal. When

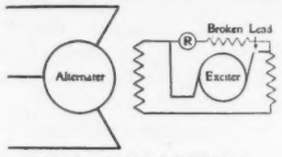


FIG. 2.—FIELD REVERSAL.

the field circuit of the alternator was broken, the stored energy was discharged through the shunt-field circuit of the exciter, the direction of the current being opposite to the normal.—*Elec. Jour.*, February.

Automatic Voltage Regulator.—A. Berthier.—An illustrated description of the Lecoq automatic compensator for compensating the voltage difference due to the losses in an alternating-current line (although with a slight modification it may also be applied to direct-current lines). It consists essentially of two parts, a voltmeter regulator and a compensator. The compensator has a two-pole primary, the windings of which are connected across the circuit to be regulated, and an armature which is connected in series with the circuit to be compensated. The position of this armature determines the voltage which is added to or subtracted from the voltage of the line. To obtain automatically the movement of this device a small induction motor is employed. To let it run in either the one or the other direction and to start it, a special double winding is used. The voltmeter regulator causes the motor to turn in the one or the other direction according to whether the tension of the circuit is to be elevated or to be reduced. This apparatus consists of two solenoids and a simple system of levers in unstable equilibrium. The construction is illustrated, and it is stated that it has given good results in practice.—*La Lumière Elec.*, Jan. 25.

Induction Regulators.—An illustrated description of automatic induction regulators built by Brown, Boveri & Co., for high-tension alternating-current systems. It is designed to follow very accurately and gradually all pressure variations so as to maintain the pressure at a constant value irrespective of the load. These induction regulators have the general form of an induction motor, and constitute a transformer having fixed primary windings and movable secondary windings; the former are wound on the stator and the latter on the rotor, a four-pole disposition of the windings being usually employed. The position of the rotor with respect to the stator is controlled by a worm and wheel, and the movement of the latter depends upon a special form of Thury governor, which, by means of a special ratchet wheel and pawl mechanism, drives the worm in one direction or the other as the pressure on a controlling relay varies from the required average value. The pressure induced in the secondary windings will vary according to their position with respect to the stator coils.—Lond. *Elec.*, Feb. 7.

Protective Devices for High-Tension Transmission Circuits. —An illustrated paper read before the (Brit.) Inst. of Elec. Eng. The author explains how severe strains due to excessive pressure rise may be caused by lightning, switching, etc., also how a concentration of potential may arise. This latter may be guarded against by choke coils; while for lightning, etc., four types of arresters are described—the horn, the multigap, water-jet and electrolytic. The last-named is considered to be the best.—Lond. *Elec.*, Feb. 7.

Protective Relays.—R. C. Rypinski.—A continuation of his illustrated serial. The author deals with direct-current reverse-power relays for instantaneous action and for inverse time-element action, and describes the principle of operation.—*Elec. Jour.*, February.

Protection of Electric Circuits.—R. B. JACKSON.—The first part of an article on the protection of electric circuits and apparatus from lightning and similar disturbances. The author gives first general considerations of static disturbances, their causes and their effects, and then discusses apparatus and other devices found effective in reducing lightning troubles. The article is to be continued.—*Elec. Jour.*, February.

Circuit-Breakers.—F. W. HARRIS.—A continuation of his illustrated serial on circuit-breakers. He discusses their methods of operation (manual, electric or pneumatic), the time-limit features, calibration, overload capacity and current-breaking capacity.—*Elec. Jour.*, February.

Electrophysics and Magnetism.

Thermoelectric Properties.—A. G. WARREN AND M. MURPHY.—An account of an experimental investigation of the thermo-

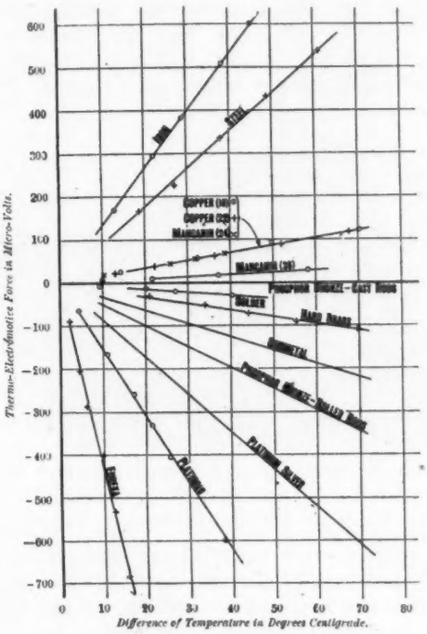


FIG. 3.—THERMO-ELECTRIC PROPERTIES.

electric properties of various common metals and their alloys against phosphor-bronze cast rods. The results are given in

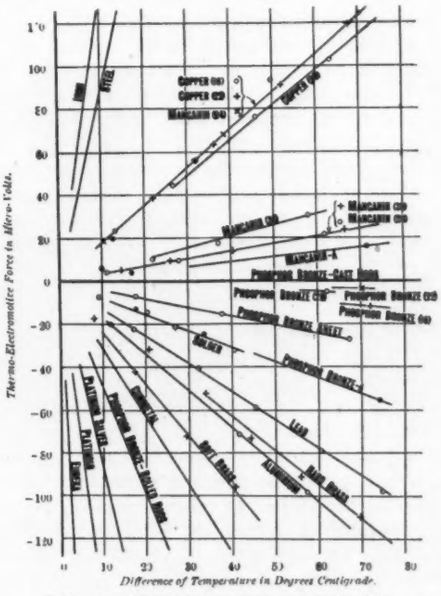


FIG. 4.—THERMO-ELECTRIC PROPERTIES.

Figs. 3 and 4. The thermo-e.m.f. is within small ranges of temperature directly proportional to the difference of temperature of the junctions. The most important point brought out by the diagrams is that different specimens of the same material yield sensibly different results. In the case of phosphor-bronze the disparity which exists between the results given by the rolled rods and the other forms is especially remarkable. Copper (16) is hard-drawn wire of 16 S W G, copper 22 and 36 are samples of high-conductivity wire of 22 and 36 S W G, respectively. They were originally covered, but the covering was removed. Manganin 24, 36, 30, 26 were wires of this material of S W G, respectively, while manganine *A* and phosphor-bronze *A* were subjected to special treatment in order to determine the magnitude of the error which may be produced at a silver-soldered junction. From the curves it will be seen that the use of phosphor-bronze, cast, sheet and wire, and manganin with manganin tappings affords a ready means of considerably reducing thermo-electric errors.—Lond. *Elec.*, Jan. 31.

Radioactivity.—E. RUTHERFORD.—A Royal Inst. paper giving a summary of recent researches on radioactivity.—Lond. *Elec.*, Feb. 7.

Electrochemistry and Batteries.

Carbon Bisulphide.—E. R. TAYLOR.—An illustrated Franklin Inst. paper describing his process for the production of carbon bisulphide in the electric furnace, with special reference to the construction of the furnace.—*Jour. Franklin Inst.*, February.

Corrosion of Steel.—A. S. CUSHMAN.—A Franklin Inst. paper giving an elementary exposé of the electrolytic theory of the corrosion of steel.—*Jour. Franklin Inst.*, February.

Units, Measurements and Instruments.

False Meter Connections.—C. HERZ.—In a three-phase network a consumer's equipment was connected to only two wires because he had installed only lamps. The energy consumed in the lamps was metered. He then wanted to install a small three-phase motor, and this was done on the two wires already available in the house, while the third wire now was also introduced into the building. The meter connections were not changed. It was then found that the consumption of energy metered after the installation of the motor was less than before. The company thought it was due to a fraud, but it was in reality due to wrong meter connections, as will be seen from Fig. 5.

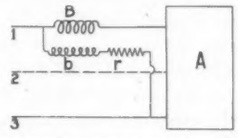


FIG. 5.—FALSE METER CONNECTIONS.

A represents the first lamps which are supplied with energy from the leads 1 and 2. The meter was so connected that the series coil *B* was in lead 1, and the voltage coil *b* was across leads 1 and 3. The energy measured is $E\ I\ T\ cos\ \Theta$, where E is the voltage across 1 and 3, I the current, T the time, and Θ the angle of time-phase difference. If now *A* represents a three-phase motor instead of lamps, it is necessary also to introduce the lead 2 (shown in dotted lines) to the motor and the energy registered by the meter $E\ I\ T\ cos\ (\Theta - 30\ deg.)$. The sign + before 30 deg. must be chosen if the current in the series coil *B* is in advance in time-phase of the current in lead 3; otherwise the negative sign must be chosen. Assume that the positive sign must be chosen, then the power will have a negative value (that is, the meter will run in the reverse direction) if the angle of phase-difference is greater than 60 deg., and such was the case in the installation mentioned. While no fraud was intended in this case, it is possible to use such connections for fraudulent purposes.—*La Lumière Elec.*, Feb. 4.

Inductance Measurements.—A. CAMPBELL.—Two (Brit.) Phys. Soc. papers. One deals with the use of variable mutual inductances in the measurement of small inductances and capacity. For a number of reasons mutual inductances are more easily dealt with than self-inductances. The author has developed a new design of a variable mutual inductance, which is described. In the second paper, several applications are taken up, especially the measurement of self-inductance, the comparison of nearly equal self-inductances, the comparison of mutual in-

ductances, the measurement of capacity, and fixed standards of mutual inductance.—Lond. *Elec.*, Feb. 7.

Thermo-Electric Couple Potentiometer.—An illustrated description of a potentiometer of a special make which is designed for measuring accurately small differences of potential not exceeding 30 milli-volts, and is intended specially for use with thermo-electric couples. The method of measurement adopted in the instrument is an extension of the well-known potentiometer method, and enables the unknown potential difference to be accurately balanced by an adjustable potential difference standardized in milli-volts by means of a standard cadmium cell. This adjustment can be made by direct reading to 1/100 milli-volt, and by estimation of tenths to 1 micro-volt.—Lond. *Elec.*, Jan. 31.

Telegraphy, Telephony and Signals.

Directed Wireless Telegraphy.—A. Montel.—A mathematical paper showing that an antenna composed of two vertical wires of equal length placed at a certain distance from each other and supplied with currents of opposite sign at any instant has the property of sending out waves in certain directions.—*Nuovo Cimento*, Oct., 1907; *La Lumière Elec.*, Feb. 4.

Block Signals.—A set of recommendations made by a committee of the Railway Signal Association as to means for remedying the effects of foreign current on automatic block signals.—Lond. *Elec.*, Feb. 7.

Wireless Telegraphy.—W. H. Eccles.—An article giving a summary of the more important patents in wireless telegraphy issued during the past year.—Lond. *Elec.*, Jan. 31.

Miscellaneous.

Magnetic Properties of an Alloy Steel.—A note giving the results of some tests made by Siegwart on sheets of a steel whose composition was 96.4 per cent iron, 3.4 per cent silicon and 0.2 per cent manganese. The author determined by the ballistic method the induction reached in the sheets and the hysteresis losses for field strengths varying between 0.0001 and 150 gauss. The results obtained show that, for inductions between 5000 and 18,000, the alloy behaves like the best of the sheets at present used, and in intense fields—for example, 105 gauss—the induction attains 17,900. This result contradicts those of Watson, who showed that for high induction these sheets were inferior to ordinary steel. As regards hysteresis losses, Siegwart shows that these alloys are greatly superior to ordinary soft steels, especially at moderate inductions. The author also made numerous measurements in weak fields, which contradicted Lord Rayleigh's statement that the permeability is constant in fields of less than 0.04 gauss. "It is regrettable, however, that the author does not describe his method of working nor the precautions taken to prevent the large errors which may occur when delicate measurements of this kind are made in weak fields."—Lond. *Elec.*, Jan. 31.

BOOK REVIEWS.

Alternating Currents. By C. G. Lamb. New York: Longmans, Green & Co. 325 pages, 251 illustrations. Price, $3, net.

In preparing this textbook the author has assumed the reader to be familiar with the principles of direct-current machines, the elements of calculus and the elementary properties of vectors. Although mathematical formulas have been used freely, the physical relations have not been overshadowed by a mass of symbols. Many numerical examples are worked out, in order to indicate the exact significance of the mathematical expressions. The author states that the symbolic treatment appeals to only a limited number of students, and hence he has not employed it in the present volume. The treatment is based largely on the use of vectors, by means of which the explanatory matter is rendered quite simple.

Much space is devoted to the induction motor, and the results obtained from the author's analysis correspond with the physical facts. However, not all of the statements made are correct, and in some cases the treatment is misleading. For example, the author correctly assumes a sinusoidal space distribution of the flux in the air-gap of an induction motor, but in explaining why the flux is thus distributed he neglects the secondary currents which are the main factors in giving the sinusoidal shape to the flux wave. The statement that an induction generator delivers a leading current into the mains and therefore tends to improve the power-factor is incorrect, as is also the statement that the machine cannot of itself produce power. To the extent that these statements contain any element of truth, they are the more dangerous for the uninformed student. It is unfortunate for the reader that what must have been an oversight allowed the author to intimate, on page 279, that the division of load between two alternators in parallel depends upon the relative field strengths of the two machines. The book contains an instructive discussion of synchronous generators and motors. Although use has been made of the familiar "synchronous-impedance" method of dealing with the phenomena in these machines, the author has been careful to call attention to its limitations and to show in what respect the real performance of the machines differs from the calculated.

Thomas Alva Edison. By Francis Arthur Jones. New York: Thomas Y. Crowell & Company. 362 pages; illustrated. Price, $2.

This is a popular review of Edison's life up to the age of 60, and is written quite agreeably and sympathetically. Several other books of the same character exist, of earlier date. Old and new sources of information have been drawn upon, and a vivid picture is presented of a notable career already so fruitful and still being run.

The personal side of the inventor's life is fully emphasized in this interesting story. The author has treated his subject as a journalist and not as a technical writer in any sense; but has quoted with discretion a good many authorities and articles dealing with Edison's real life work as distinguished from the ordinary credulous acceptation of him as a "wizard."

Alternating Currents. By Alexander Russell. New York: The Macmillan Company. 407 pages; 132 illustrations. Price, $4.

Seldom, indeed, does an author of a book on electrophysics attempt as much as the author of the present volume. Mr. Russell set before himself the task of giving in an accurate and thorough manner a treatment of the multitude of details involved in alternating-current phenomena and to render the treatment within the understanding of engineering students. The treatment is essentially mathematical, but the author has exercised excellent judgment in making a liberal use of physical interpretations of the equations. He has kept the book within the 400-odd pages by omitting all matter of a purely descriptive nature and confining the discussion to theory. In fact, no treatment is given of transformers, motors, generators or converters, only the elementary circuits that are used in and with these machines being dealt with. The author is to be congratulated on having accomplished his task.

A Brief Guide to Vibratory Technique. By Noble M. Eberhart. Chicago: G. P. Engelhard & Company. 124 pages; 4 illustrations.

The author, who is a Chicago electro-therapeutist of standing, introduces this work with a clear statement as to the position which he thinks vibratory treatment should occupy, not as a cure-all, but as a means of effecting a cure in some cases, and in other cases as an adjunct to other treatment. It points out briefly the therapeutic action of vibratory treatment, and gives cautions as to cases where it should not be used. The remainder and greater part of the book is taken up with technical medical directions as to the treatment for various diseases. Since portable vibrators operated by small hand motors have become common, central-station men may find the book useful in connection with the introduction of vibrators among the local medical fraternity.

American-Ball "Angle Compound" Engine.

A new type of high-speed engine, the joint design of Mr. F. H. Ball, the well-known engine designer, and his son Mr. F. O. Ball, is being placed on the market by the American Engine Company under the name of the "Angle-Compound" engine.

The designers of the engine have sought to attain the extreme

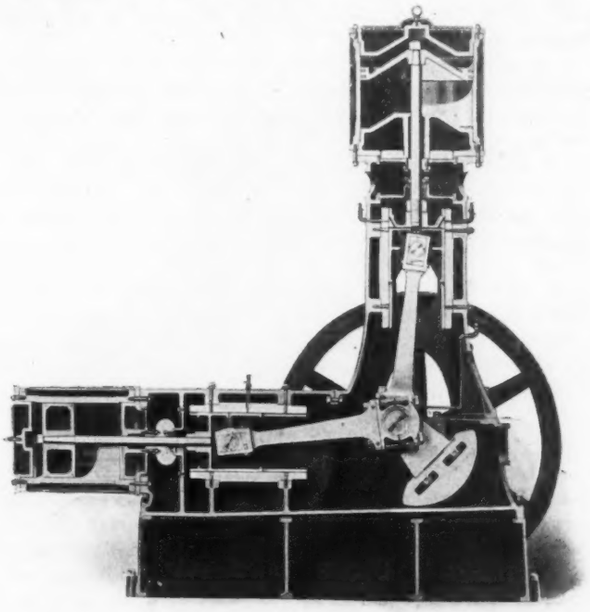


FIG. 1.—SECTIONAL VIEW OF "ANGLE COMPOUND" ENGINE.

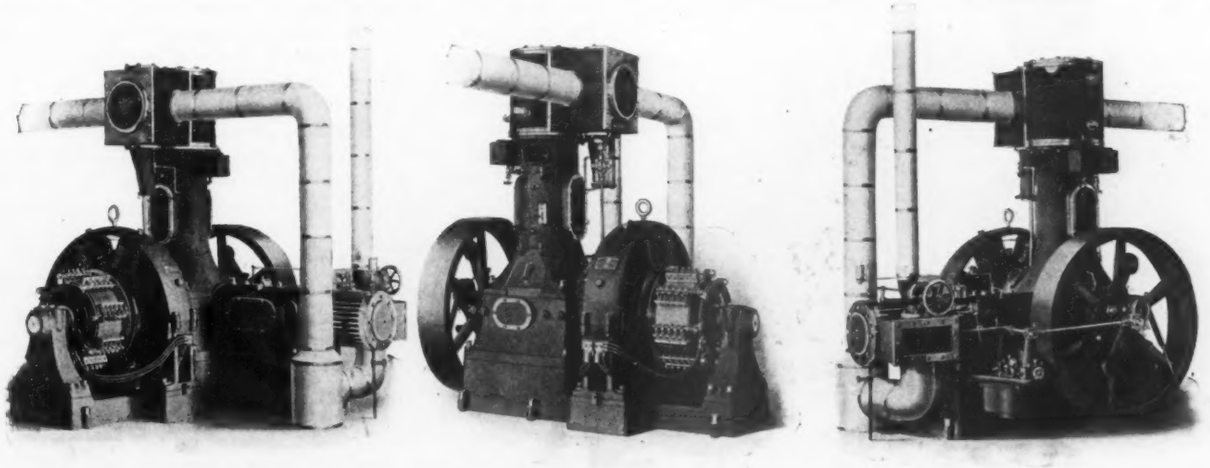
of simplicity and fewness of parts. While the general plan of combining a horizontal engine and a vertical engine so that both shall work on the same crank-pin is not new, there being conspicuous examples of this general type in the great engines installed in the traction power houses of New York City, engineers have not generally appreciated the many desirable features of this arrangement for high-speed engines of the single-valve type. By combining a horizontal and vertical engine on the same crank-pin, to total amount of horizontal thrust may be neutralized by counterbalance; and when the counterweight is in a vertical plane, it is opposed by the reciprocating parts of the vertical engine, so that at four points of the stroke a perfect balance is realized, and between these four points there is no position of the crank where any appreciable unbalanced condition is found.

In the "Angle-Compound" engine the conditions for perfect balance are brought about by making the low-pressure piston a very light, conical-shaped, steel structure of about the same weight as the ordinary cast-iron piston in the high-pressure cylinder. The low-pressure engine is made the vertical engine because it is thought desirable to have the larger piston rest on the piston rod rather than to drag in a horizontal cylinder.

It will be seen by reference to the several views of the engine that the high-pressure valve is driven by the usual valve gear and shaft governor, and the low-pressure by an eccentric which is enclosed in an oil-tight casing and connected with the oil-circulating system of the engine. From this eccentric a rod drives direct to the low-pressure valve stem, which is guided by a cross-head carried in guides, as shown, and this cross-head and guides are also included in the oil-circulating system of the engine. This oil-circulating system is similar to that used on the well-known American-Ball engines, except that the oil is pumped directly to the gravity storage tank on the low-pressure frame, which is kept constantly overflowing by the supply delivered to it from the pump. A double stuffing-box on the valve stem and bulkheads, and stuffing-boxes on both piston rods, prevent the water drip from mingling with the oil of the circulating system. The water drip from all these stuffing-boxes is carried off by concealed piping, so that the engine is never untidy in appearance.

A new departure has been made in the arrangement of the cross-head and guides, which are of the bored type. The cross-head is a single piece without the usual adjusting shoes, while the guides are made adjustable. These guides are carried in bored seats, and a projection from the back of the guide fits between the supports so as to resist end thrust. One of the guides is secured to the support by screws, and is only adjustable by means of shims, but the other has a pair of screws at each support to provide for delicate adjustments, and the guide is securely held against these adjusting screws by a bolt that locks the adjustment securely when set up. It is, of course, understood that the crank-pin is double the usual length, and that the connecting rods are placed side by side on this double-length pin.

The builders' claim that this type of engine runs more smoothly and with much less strain and shock than any other form of high-speed engine, because of its perfect balance and because it has four small impulses on the crank at each revolution instead of two large ones, would seem to have every justification. They have recently installed in their own power plant one of the new engines of 160-hp, 11-in. stroke, running about 300 r. p. m., direct-connected to one of their generators. This engine has no special foundation, except the concrete floor of the building, and has not a single foundation bolt. Nevertheless, a new full-length lead pencil may be stood on its end on the horizontal cylinder head and then on the vertical cylinder, there not being vibration enough to disturb the delicate balance of the pencil, even with a fluctuating load on the engine.



FIGS. 2, 3 AND 4.—THREE VIEWS OF A DIRECT-CONNECTED UNIT.

The floor space of this engine is very small for a given rating, since the horizontal engine carries a vertical engine of the same power. This also reduces the cost of foundation to the same extent, so that practically half the foundation is saved, and the balance of the engine makes the foundation problem such a very simple one that where concrete floors are used, no further foundation is ordinarily required.

For large powers these engines, combined in pairs with the generator or belt wheel between them, make an exceedingly compact unit. In these combinations the engines are used as double compounds when run non-condensing; or, where condensing water is available, as four-cylinder, triple-expansion engines. In the latter case one horizontal engine is the high-pressure, the other horizontal the intermediate-pressure, and the two vertical engines combined are the low-pressure, thus giving a large area of low-pressure piston without using any pistons of very large diameter.

Since the normal speed of an engine of this kind is high, the cost of the generator and the amount of floor space are both greatly reduced.

Developments in Motor Applications.

The universal application of electric power to supersede mechanical and manual power is no longer a question of the adaptability of the motor, for there is scarcely a service that can be mentioned for which the motor has not demonstrated its superiority in one way or another.

Many types of machines now in use owe their adoption entirely to electric power; many that formerly employed mechanical power are now chiefly heard of in connection with electrical power. The number of machines that are coming over to the electrical side is constantly increasing. As typical among them may be mentioned ironing machines, vacuum cleaners, blacksmith forges, brickmaking machinery, concrete mixers, stereotyping machinery and portable machines of various types.

IRONING MACHINES.

Motor-driven ironing machines are already well established in laundry service. Their success has led to the extensive manufacture of domestic machines, in connection with which the electric motor is of even greater importance, for the reason

FIG. 1.—IRONING MACHINE.

that mechanical power if available would not be tolerated in the household. These machines iron all of the flat work as well as it can be ironed by hand. A girl operating the machine can perform five to ten times as much work as she could without it. Naturally this argues that it would require a very short time for an ordinary ironing and that the machine would be best suited for large households. True, its capacity is sufficient for the very largest domestic establishments and even for restaurants and small hotels, but the beauty of it is that it is economical for even a small family, for its operation only requires an eighth horse-power motor.

FLAT-IRONS.

The convenience and cleanliness of electricity for this purpose readily leads to a demand for electric irons for such work as must be done by hand. The Westinghouse 5-lb. iron costs about 4 cents per hour on the basis of a 10-cent rate. This does not seem expensive, but if an argument is raised, the cost is effectively offset by the advantages gained in comfort, in steps saved, and in always having the iron at the proper temperature.

It is often argued that most people who have their houses wired have a servant to do the washing and ironing, and that they don't care if she does have to walk back and forth and if the fire that heats the irons does make her perspire and put her in a bad temper, for that is what she is paid for. There may be some such, but ninety-nine out of one hundred who know the difficulty of keeping good servants, will be willing to have their burdens lightened for purely selfish reasons if for no others.

The one stumbling block is first cost, but the cost of an electric motor, like everything else, should be reckoned in proportion to its life and distributed over its period of useful service instead of charged to the expenses of the current month or year.

PORTABLE VACUUM CLEANERS.

Another household convenience dependent upon electric power is the small portable vacuum cleaner which in appearance resembles the ordinary carpet sweeper more than it does the large vacuum cleaners which have been on the market for some time. It consists of a motor-driven exhaust fan which draws the air from the carpet through a slot in the machine and carries with it the dirt and dust. The dirt does not come into contact with the fan, but is retained in a special receptacle which is screened off from the fan by means of a fine cloth. A flexible hose attachment provides for the cleaning of walls, furniture, etc.

This machine has been found to be very satisfactory for residence, church and small hotel work. It can be moved from room to room and attached by means of a flexible cord to any lighting socket. Cleaning by this method is several times cheaper than by use of broom or carpet sweeper and can be done at any time desired instead of periodically, as when a contractor with a vacuum outfit is employed. Those who have been employing contractors occasionally can, by owning one of these machines, apply the same method of cleaning every day in the year if desired. Its low cost and the fact that it does equally well the cleaning that many have been willing to pay contractors a high price for doing, argue that it should become very popular in the larger households. Like other domestic apparatus, its introduction depends mainly upon the central station, and should be pushed with energy because it means in addition to a sale of the article, the continuous sale of the current it uses.

CONTRACTORS' SERVICES.

The portable steam engine has so long been looked upon by contractors as an entirely satisfactory part of their equipment that it takes pretty good performance upon the part of the motor to get them to concede its superiority, but recent experiments with Westinghouse motors in every branch of contracting service have demonstrated that they produce economies in time and operating force that deserve careful consideration. A strong point in favor of the motor is its simplicity. Whereas a licensed engineer is required to run an engine, any workman of ordinary intelligence can operate the motor. Its power supply requires nothing but a feed wire, while the steam engine requires fuel and water and the removal of ashes. The motor eliminates the smoke nuisance and the fire risk from flying sparks. It requires less space than the steam engine and offers greater latitude in the matter of location.

The use of motors for driving concrete mixers has been found especially satisfactory, since the wide variations in the

load are more satisfactorily handled by a motor than by either a steam or gas engine.

ELECTROTYPING AND STEREOTYPING.

In electrotyping and stereotyping, recent experiments have demonstrated the superiority of the electric heater for the many steps in the processes that require heat. The electric heater reduces the fire risk and does away with the noxious fumes inseparable from the use of the gas flame. It concentrates the heat at the point where it is desired and greatly facilitates the operations, thus both increasing the capacity of the machine and decreasing the time required to deliver the finished plates.

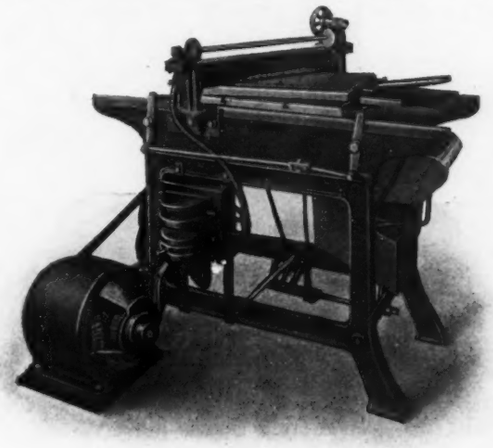


FIG. 2.—STEREOTYPERS' WAX TRIMMING KNIFE, ELECTRICALLY HEATED.

Special attention has been devoted by the Hadaway Company to the perfection of heating devices for the publishing trades and the satisfactory results obtained will undoubtedly lead to their wide adoption.

PORTABLE TOOLS.

The flexibility of the electric motor, admitting of its attachment to portable tools, is responsible for many conveniences and improvements in shop work. An example of this application is afforded by the portable lathe for use in locomotive repair shops. Where every bolt has to be fitted, as in this case, the advantage of bringing the tool to the work instead of carrying the work back and forth, is readily apparent. Through the use of a flexible feed wire and plugs, which may be located at convenient intervals, the motor-driven tool is always available regardless of the location of the work.

BLACKSMITH FORGES.

While many applications of electric motors are confined to particular territories, the blacksmith forge furnishes an application that is to be met with everywhere. As a rule, mechanics do not like to spend their time on work that does not require their skill, but this is what the blacksmith does if he works the bellows handle or turns the crank himself. Of course he may have a helper, but he will hardly prefer one to an electric motor, when the latter does the work equally well at about one-tenth the cost. Moreover, the motor makes him independent of the labor market and is always ready to work when he is.

The newest type of outfit driven by a Westinghouse motor is simplicity itself and can be operated by anyone after a few minutes' instruction. The fan is mounted on the same shaft as the motor without separate bearings and forms a very compact unit. The blacksmith can start the motor by a single turn of the switch, adjust the blast gate for the heat desired and then turn his attention to some other duty while the work in the fire is heating. It pays the central station to have motors in use where they will be seen and a motor in a blacksmith shop, especially in smaller places, has considerable value as an advertisement.

BRICKMAKING.

The machinery used in brickyards has until recently been entirely or in part driven by steam engines, but during the past year a new brickyard has begun operations where the most modern apparatus is used, with motor-drive throughout. There is no provision for any power other than electric and that is purchased from a nearby central station. Some steam is made for heating the die and the material as it is pressed out of the auger; but even though the company operating the brick plant owned and operated a nearby coal vein, the installation of a steam engine was not considered so satisfactory as the use of the purchased power from the central-station mains.

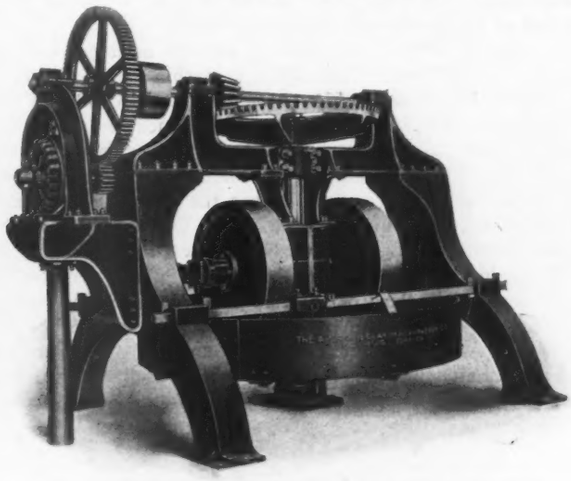


FIG. 4.—9-FT. DRY PAN FOR PULVERIZING BRICK MATERIAL.

The machines are individually driven by two-phase induction motors of standard Westinghouse design. The process of making bricks is a continuous one, so that all the machines run at the same time. Furthermore, barring accidents, there is no reason why the machines should not run steadily all day, unless there is a shortage of material. For this reason the usual economies of electric drive, permitting an idle machine to be shut down, do not exist in making bricks. As the load is very steady all day long and is large in size, the best rate of the central station was made and has proved entirely satisfactory.

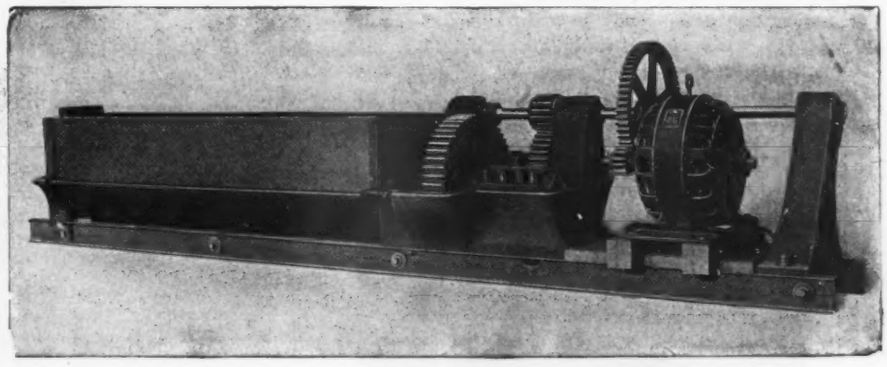


FIG. 3.—PUG MILL FOR MIXING BRICK MATERIAL.

It is to be noted that in the plant mentioned the bricks are dried in a tunnel by the heat from ovens where the bricks have been burned and are being cooled. The air is moved by

large fans which operate normally during the night, allowing the bricks made during the day to dry over night, so that they are ready to be set during the following day. This use of power all night long also makes the installation particularly attractive to a central station.

WOODWORKING.

The use of electric drive in planing mills has grown rapidly because of the many advantages of electrical drive as well as the economy resulting from the use of central-station power. The older forms of equipment consisted of a line shaft from which the individual machines were belted with tight and loose pulleys. The line shaft had to be kept in motion irrespective of the number of machines at work.

As a matter of fact in a planing mill the machines are not working all the time. Even when a machine is in operation the work it does is intermittent because material cannot be fed through it without absolute continuity. Hence the power demand of any tool is fluctuating. It is also evident that the power required when working on hard wood is more than when working on soft wood. Hence the inflexible line shaft system of driving is not as suited to this class of work as the flexible method using motor-drive for each machine. The usual planing mill shows that the average power required is approximately one-third of the connected power of the motor.

Because of this intermittency of operation the central station supply of power has been gaining ground and gas-engine as well as steam-engine equipments have been displaced. As the power is used all day long the planing mill receives the benefit of the central-station rates for long-hour service.

Automatic Time Switches.

Two new types of automatic time switches have just been placed on the market by the Hartford Time Switch Company, 97 Warren Street, New York City. Of these, one is made from 75 amperes to 300 amperes, 250 volts, in single, double and triple-pole, and is a combination of the "Hartford" time switch and a standard knife switch operated by a pair of solenoids, one for opening and one for closing the circuit. The operation is as follows:

When the time is reached when the main circuit is to be closed, the operating switch is automatically thrown in contact by the time switch, which energizes the closing solenoid, and the closing of the main switch itself automatically cuts out the solenoid after its work is done. As the several operations are all performed with great rapidity, the solenoid is only in circuit the fractional part of a second.

The operation of opening the main circuit is similar to the closing; the break is practically instantaneous and the same automatic cutting-out of the operating solenoid takes place. The safety of the solenoids is carefully guarded to remove any possibility of their being burned out or injured; if for any reason the safety factors already mentioned as guarding the

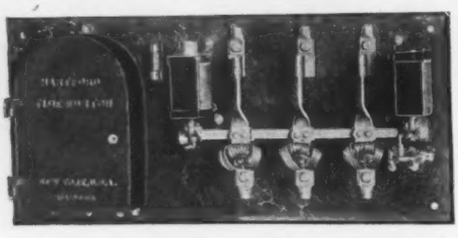


FIG. 1.—AUTOMATIC TIME SWITCH.

solenoids should fail to work, a final safeguard is provided in a fuse that blows before either solenoid could be injured. The whole switch is very simple and entirely self-contained. In installing it is only necessary to connect the line with the switch in the usual manner, and set and wind the time switch, as all the wiring for the operation of the solenoids is mounted with the switch.

The other switch referred to is for high-potential circuits and operates much as that first described, excepting that the break of the main switch takes place in an oil chamber. In this switch the handling of the high-voltage current is covered with every safeguard to prevent leaking or short-circuiting. All leads are through porcelain and glass to the oil chamber, and

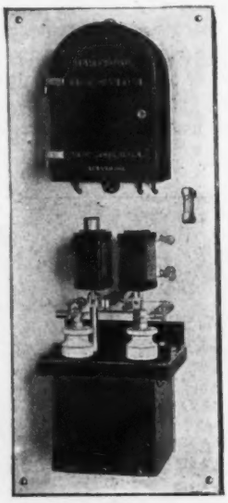
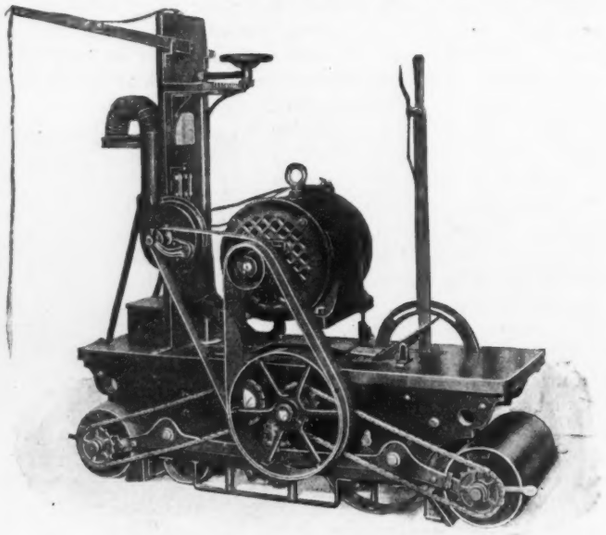


FIG. 2.—TIME SWITCH FOR HIGH POTENTIAL CIRCUITS.

the switch proper is constructed both with great solidity and with a large excess of carrying capacity in the blades and contacts. In operating the solenoids in this type, when no independent secondary low-voltage current can be used, a small transformer is mounted on the same board with the switch, for use on the solenoids only. As before-mentioned, the current is drawn on for the solenoid operation for only an instant, and the same safeguards mentioned in the other switch are used.

Single-Phase Floor-Surfacing Machine.

It is claimed that the floor-surfacing machine illustrated herewith will do as much work as 20 men, the results being better and the cost less. The sand-paper drum is of such dimen-



MOTOR-DRIVEN FLOOR-SURFACING MACHINE.

sion as to insure the best finish, which is impossible to accomplish by hand-work. The machine is adapted to the surfacing of every class of floor, from pine to the finest parquetry. By a very slight change of the drums, it can be arranged to polish and wax floors. The machine is made by the American Floor-Surfacing Machine Company, Toledo, Ohio; it is operated by a 5-hp, self-starting, single-phase motor manufactured by the Century Electric Company, St. Louis, Mo.

Cradle-Type Direct-Current Motor.

Fig. 1 herewith shows the Bliss cradle-type of direct-current motor built by the Engineering Specialty Company, of 143 Liberty Street, New York. The motor has a square frame for

FIG. 1.—CRADLE-TYPE MOTOR.

convenience in attaching gear shafts, brackets or other fixtures directly to the motor frame. The most distinctive feature of the design is the cradle for supporting the armature bearings and brush-holders. One end of the cradle is enlarged for convenient and accurate attachment to the motor frame. This is shown clearly in Fig. 2. As both bearing sleeves are carried in one rigid casting, there is no possibility of defective alignment with resulting heating and cutting of the shaft. Another advantage is that the cradle arms occupy the space between the pole tips and are so proportioned that their effect on the armature is to provide a neutral magnetic field on the line of com-

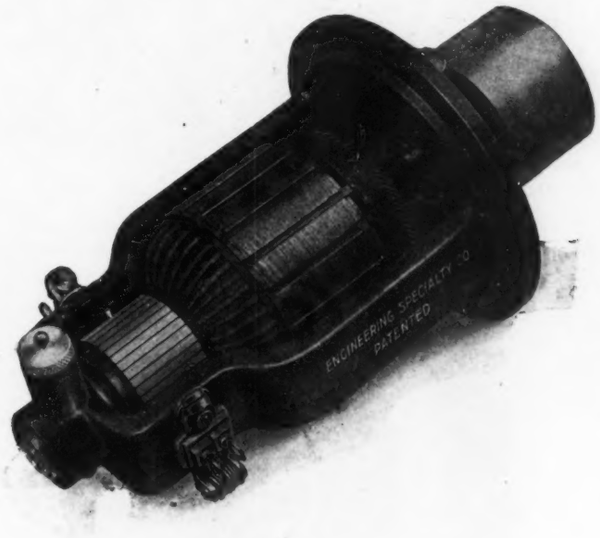


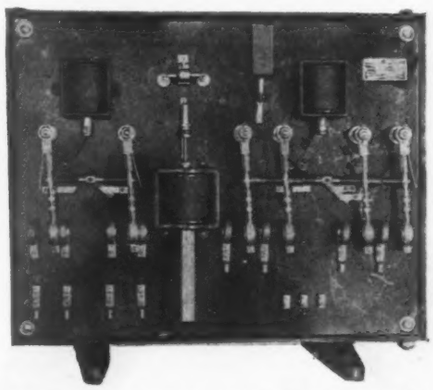
FIG. 2.—ARMATURE IN CRADLE.

mutation, thus aiding in securing sparkless operation. The cradle also carries the brush-holders, each of which is secured by two insulated screws. Double brush-holders are used in all but the smallest sizes of motor. By removing four screws, the entire cradle with its armature, brush-holders and bearings can be removed from the frame. The armature is provided with a removable shaft. The construction of the various parts of the motor conforms to general practice. All parts of the motor are interchangeable and are accurately fitted. The motors may be rendered dust proof by a cap which fits closely over the commutator end.

Alternating-Current Motor Auto-Starter.

The accompanying illustration shows a new magnetically-operated auto-starter and transformer for alternating-current motors of the slip-ring type, now being placed on the market by the Automatic Switch Company, of New York.

The main-line switch at the right of the panel may be closed or opened by contact devices of an automatic type, such as a pressure regulating pilot switch, a thermostat, tank switch or manually-operated push buttons from a distance. At the center of the panel is shown a solenoid magnet having a dash-pot so arranged that upon the closing of the main-line switch the magnet is energized and lifts the core to the top of its stroke where by its own movement it opens the circuit supplying current to this magnet. In doing so, by means of the small magnet shown at the top of the panel, this circuit is also opened, thus allowing the core in the dash-pot controlled magnet to fall slowly until at its lowest point it closes a contacting switch, which throws the switch shown at the left of the panel from



ALTERNATING-CURRENT MOTOR AUTO-STARTER.

the low-voltage position at which it has stood to the high-voltage position, thus affording full voltage to the motor. The time allowance between the closing of the main-line switch and the throwing of the two-voltage switch to the full-voltage position may be regulated by the consistency of the oil in the dash-pot attached to the center magnet, and thus the motor may be allowed low voltage long enough to accelerate. By this means the inrush current is kept down to a normal and reasonable amount. None of the magnets carries current after it has performed its function. In stopping the motor, current is supplied both to the right- and left-hand switches simultaneously from the contacting device, throwing both these switches back to the original position ready for a repetition of the cycle of starting.

This device is regularly built in sizes from 3 horse-power to 100 horse-power and for 220 and 440 volts.

Electrically-Equipped Screw Pump.

The new Claiborne Station, of the New Orleans Railway & Light Company, New Orleans, has an interesting feature relating to the condensing apparatus and the means taken to prevent the sediment from the Mississippi River being drawn into the condenser intakes. Four 72-in. pipes have been provided to serve the condenser intake and discharge. All extend through the levee, and three are installed under the boiler room and one placed under the railway tracks between the boiler room and the levee. The pipes are made in 30-ft. lengths

of ½ in. riveted steel, protected by a coating one-sixteenth of an inch thick applied by dipping the sections into a hot compound.

The provision made for removing sand and silt from the water pipes is comprised of water jets installed at 10-ft. intervals in the bottom of the pipes, and by a system of valves the intake and discharge may be connected at the station end with an Allis-Chalmers motor-driven screw-pump so located as to secure a flow of from 8 ft. to 10 ft. per second through the pipes. When the cleaning is to be done, the jets are first operated to loosen the deposit, which is then worked out by the flow from the pump. The pump is driven by means of a 700-hp, 550-volt induction motor directly coupled to it and in construction of its hub, guide vanes and bearing above the propeller wheel is identical with that used on the large Allis-Chalmers screw-pumps built for the New Orleans Drainage Board.

Motors for Driving Fans.

The B. F. Sturtevant Company builds such a variety of fans that it has been found necessary to have motors of all speeds and capacities, including some of special design. An adjustable-speed motor for driving centrifugal fans, shown by the accompanying engraving, Fig. 1, is rated at 15 horse-power, and has the remarkably low speed and great variation of from 80 to 165 r.p.m. Fig. 2 shows two views of the Sturtevant eight-pole motor of very low speed, less than 100 r.p.m., for driving large ventilating fans. This motor is placed on a steel-plate

FIG. 1.—FIELD STRUCTURE OF ADJUSTABLE-SPEED MOTOR.

base and is connected to the fan shaft by a coupling. Fig. 3 shows a Sturtevant eight-pole motor arranged for attachment to the side plate of a fan. No supporting base is necessary for this type, and the fan wheel is keyed to the shaft of the armature, thus making a very compact set. In this type the shape of the motor case is such that the commutator and brushes are protected even if used as a semi-enclosed motor.

A unique ventilating set of small size, which is both convertible and portable, is shown in Fig. 4. This set is particularly applicable for use in power plants and machine shops for ventilating the power house and for blowing dust out of machinery. It can easily be carried about by a man, and by taking out the bolts of the side plate can be made to discharge air in any direction. These sets have dust-proof motors, which may be placed on either side of the fan. An aluminum casing makes the set of the least possible weight, while the ball-bear-

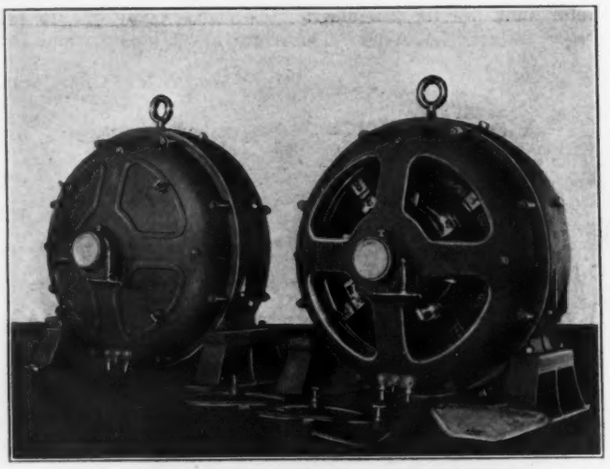


FIG. 2.—LOW-SPEED EIGHT-POLE MOTOR.

ings reduce the power required and insure a smooth-running machine. This set is made in two sizes, one of which weighs

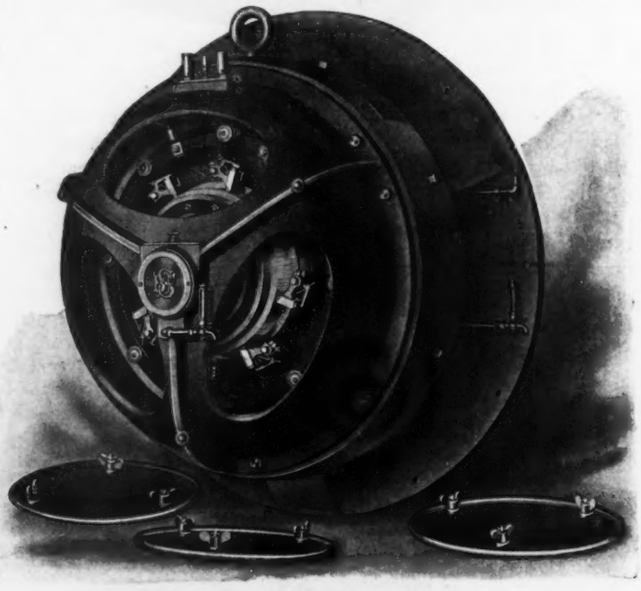


FIG. 3.—MOTOR FOR ATTACHMENT TO SIDE PLATE OF FAN.

75 lb., and the other 100 lb. They require less than one-half horse-power, and the outlets are so small that a flexible hose

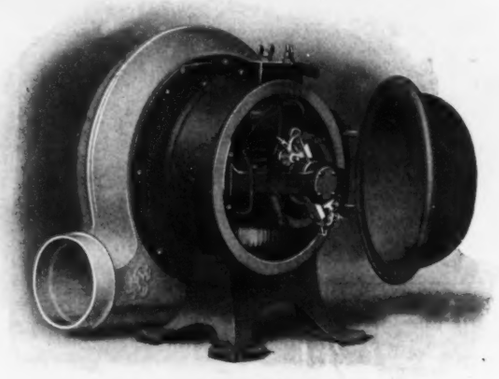
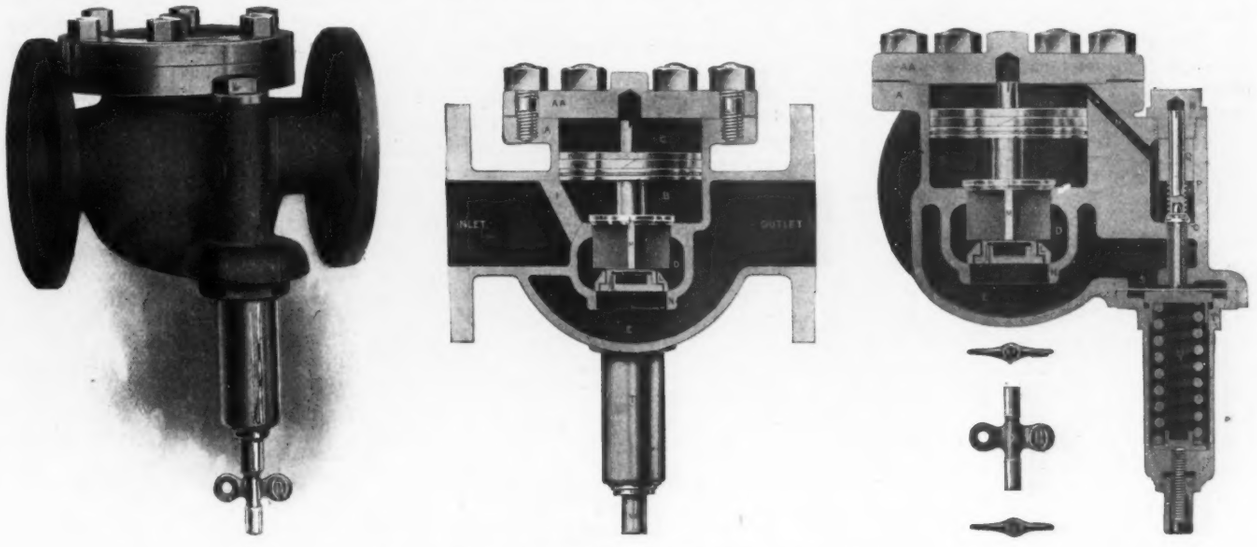


FIG. 4.—PORTABLE ELECTRIC VENTILATING SET.

may be connected thereto, thus conducting the current of air wherever desired.

For ventilating engine or boiler rooms where it is not necessary to have the set portable, an electric propeller fan is commonly used. This fan, which is shown in Fig. 5, has a small direct-connected motor, and can be placed either vertically or horizontally. The great advantage of the electric fan over either the pulley-drive or the steam engine is that of location. The fan may be placed where it will be most efficient, while the speed controller may always be placed in a convenient location. The speed of the fan is thus under instant and absolute control.



FIGS. 1, 2 AND 3.—STEAM-PRESSURE REGULATING VALVE.

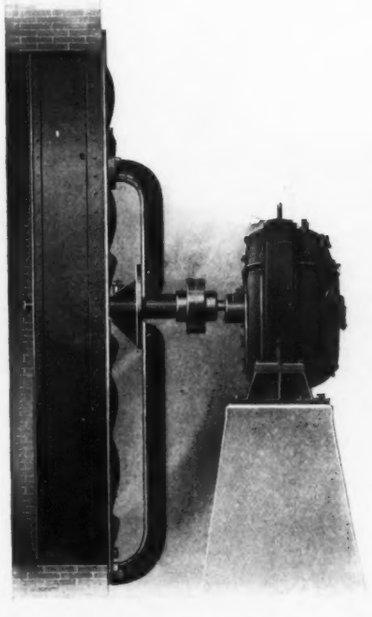


FIG. 5.—STURTEVANT MOTOR ON SEPARATE CONCRETE FOUNDATION.

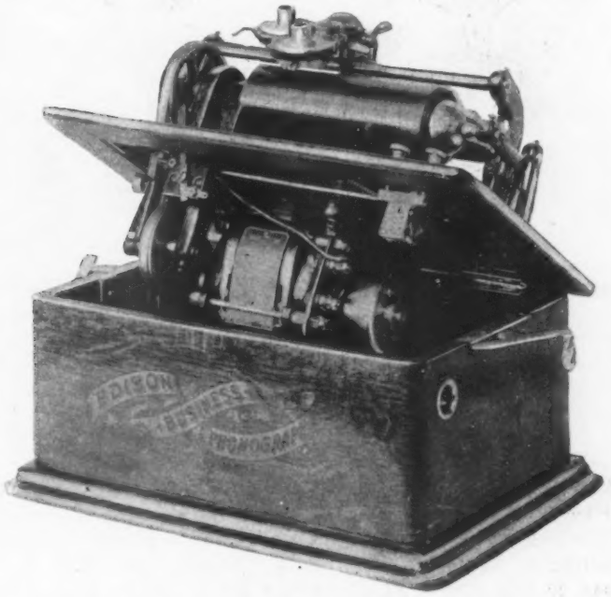
Steam-Pressure Regulating Valve.

The valve shown in the accompanying illustrations is designed for maintaining a uniform low-service pressure when the steam is obtained from a boiler at a high pressure, which latter pressure may vary throughout a considerable range. The main valve is operated on the "relay" principle; an auxiliary valve, the opening or closing of which depends solely upon the pressure of the delivered steam, serves for producing the required unbalanced thrust for opening or closing the main valve. The auxiliary valve, shown at *O* in Fig. 3, is opened by means of the spring *U* and is closed by the diaphragm *S* when the pressure of steam in the outlet reaches a predetermined value. When the auxiliary valve *O* is open, steam passes through port *H* from chamber *C* and the excess pressure in chamber *B* opens the main valve *J*. When sufficient steam has been admitted to the outlet chamber *E*, the pressure on the diaphragm *S* increases and closes the auxiliary valve *O;* steam which passes through a small hole drilled in the main piston enters chamber *C* and causes the main valve *J* to close. It is stated that the main valve actually floats, opening or closing at the slightest change of pressure above the piston.

The pressure regulating valve described above has been placed on the market by the Ohio Brass Company, Mansfield, Ohio.

The Electric Motor for Phonographs.

The accompanying illustrations show the alternating-current motor which the General Electric Company has built for the Edison business and amusement phonographs. The construction used is of the well-known riveted-frame design, in which the maximum radiating effect is secured for the stator punch



BUSINESS PHONOGRAPH EQUIPPED WITH INDUCTION MOTOR.

ings, the ends of which are directly and completely exposed to the air. The shape is that of an irregular hexagon, which form was chosen to permit the motor's meeting the requirements of assembly in an existing framework.

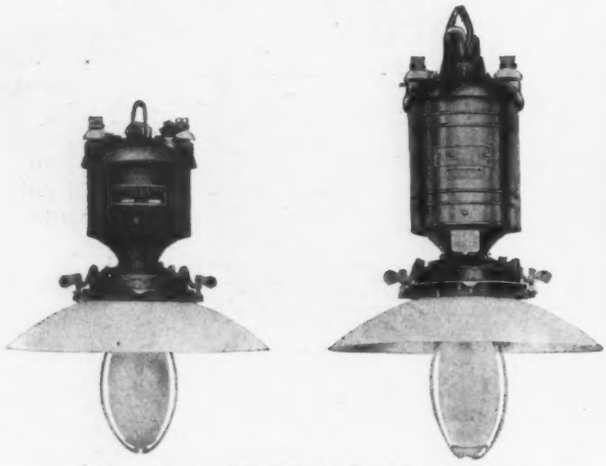
The end caps containing the bearings and lubricating devices are held in place by four bolts, two of which pass through holes in the punchings. The armature is very carefully made and balanced, and its shaft is extended at both ends beyond the caps. One end carries the pulley, which is belted to the phonograph mechanism, while the other one supports the moving element of a centrifugally-operated switch used for opening the starting phase of the winding after the armature has attained nearly full speed. A convenient terminal board is provided with means for clamping the leading-in wires and for changing direction of rotation by reversal of starting-phase leads. Tests of these motors made under actual service conditions have shown, especially with respect to heating and quietness of operation, how skilfully a design has been worked out and the construction work refined for a motor that is actually of only 1/100-hp capacity. By its use in the phonograph, our friend the business man can dictate where and when he pleases and his letters can be prepared for his signature in a separate room where the disconcerting noise of the typewriting machine may be confined, and where the operators may work at an increased efficiency because of having but one operation to perform.

Enclosed Arc Lamp for Indoor Lighting.

Recent experiments of the Western Electric Company, in which comparisons were made of the light from the enclosed arc lamp and that from the various types of lamps recently developed, are stated to have demonstrated that the latter will not be serious competitors of the enclosed carbon arc where the distinguishing of colors is an important factor.

The problem of obtaining the best light distribution is also one that must always be considered by the engineer in selecting the proper type of illuminant for certain classes of illumination. Often in indoor illumination where the ceilings are low the carbon arc lamp is found unsuitable because its length does not permit of getting the light at the exact points desired. This one feature of the arc lamp has been the most serious objection to its use in indoor lighting. To overcome this and thereby still further establish the superiority of the enclosed arc lamp, the Western Electric Company has developed a special type, the "Hawthorne" short arc lamp, for indoor service. (See Fig. 1.) This lamp is only 20 in. long over all, and will permit of even distribution of light with the lowest ceilings. The glassware used on this lamp is of the same standard size used on the longer lamps, permitting of the use of both long and short lamps in installations without the necessity of carrying two lines of glassware. This lamp burns 100 hours with one trimming, and it is stated that in no way have the efficiency and utility of the lamp been sacrificed in order to reduce the length.

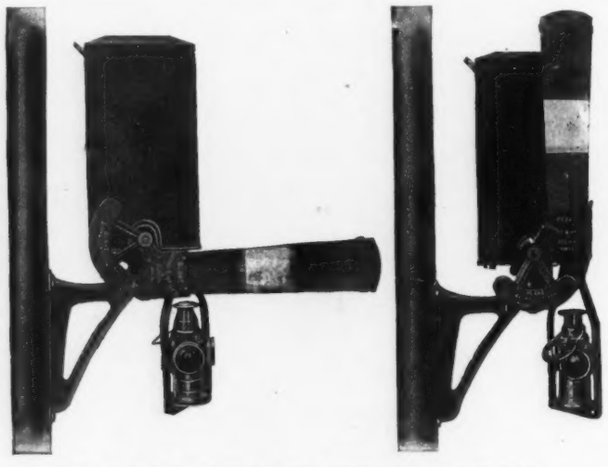
Another feature that has recently been developed by the Western Electric Company in its arc-lamp designs is the indicating drop. This feature consists of an indicator which is ordinarily concealed within the case of the lamp, but drops through a slot in the lower part of the case when the lamp requires trimming. (See Fig. 2.) This feature is especially valuable where the lamps are not burned for definite intervals of time and need not be trimmed regularly. Without such an indicator, it becomes necessary to inspect the lamps regularly in order to insure against failure due to the carbons being consumed. With the indicator, warning is given before the carbon is totally consumed, and any danger of failure on this account is eliminated. It is also more economical in carbon, for by this system the carbon will be completely consumed in each case, while with the method of trimming at certain intervals of time, and especially where the lamp operates intermittently, it is frequently necessary to discard carbons that would last for several hours if allowed to remain.



FIGS. 1 AND 2.—"HAWTHORNE" SHORT ARC LAMP.

Signals for Single-Phase Electric Railways.

In order to meet the requirements of single-phase electric roads and steam railroads, the Blake Signal & Manufacturing Company has developed the type of signal shown herewith. These signals are similar to the company's dispatcher's signals, for telephone train dispatching, now in use on many 500-volt interurban electric roads, excepting the signal light for use after dark. On 500-volt trolley lines the most effective as well as simplest and cheapest method of getting the light for night use was to connect the 500-volt trolley or feeder circuit to an incandescent lamp circuit through a certain amount of resistance, the circuit being closed by a switch when the semaphore was set in the horizonal position. With single-phase lines or steam railroads electricity with this comparatively low tension was not available at the line signal, and it became necessary to devise some other means for getting the necessary signal light for night use.



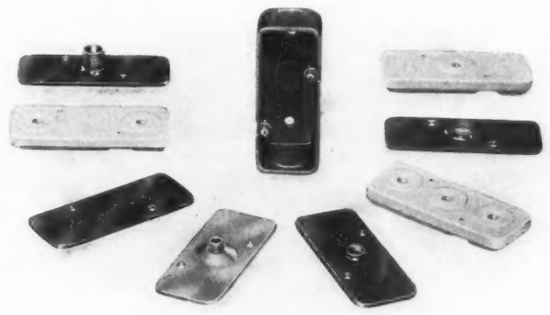
FIGS. 1 AND 2.—SIGNALS FOR SINGLE-PHASE RAILWAYS.

This has been accomplished by supporting a standard four-lens railway switch lamp on a substantial hanger, the shaft of which goes up through the base of the signal. The end of this shaft is so connected with the semaphore shaft that when the semaphore drops to the horizontal position the lamp shaft and lamp are given a quarter turn, so that where the lamp shows a white or green light up and down the track when the semaphore is in the vertical, or "clear" position, it will show a red light up and down the track when the semaphore is set to the horizontal or "stop" position. The weight of the hanger and lamp is supported on a spiral so that not only does the weight of the lamp assist rather than retard the dropping of the sema-

phore to the horizontal position, but should the road or pin connecting the lamp shaft with the semaphore shaft be broken the lamp would of its own weight make a quarter turn and show a red light. This is on the side of safety and makes it impossible for the lamp to show anything but red when the semaphore is set at danger. As with all switch lamps, whether of the fork or socket type, it is impossible for a lamp to be put up showing the wrong light; that is, a light at variance with the position of the semaphore. All of the working parts of this lamp hanger are under the signal cover, where they are thoroughly protected against the weather.

Utility Box for Open-Work Wiring.

The Bossert Electric Construction Company, of Utica, N. Y., has designed the utility box shown in the accompanying engraving for open-work wiring in mills, warehouses, station platforms or other similar places where this system of wiring is used. The chief feature of advantage claimed for the box is the fact that it is provided with a number of plugged outlets giving it a wide range of application by enabling the contractor to run



UTILITY BOX FOR OPEN-WORK WIRING.

conduit into the box from either of the four sides or the bottom and obviating the necessity of carrying in stock a large number of special fittings, each one made for the particular purpose for which it is to be used. The box is provided with holes on the bottom for supporting screws, enabling it to be fastened in position independent of the conduit; and for this reason a more rigid installation is secured than where the conduit alone is supported. The box is provided with porcelain covers having one, two or three openings for drop cords or arc lamps and with steel covers with nipples for stage or window lighting. The box is made for either ½-in. or ¾-in. conduit.

Combined Electric Washer and Wringer.

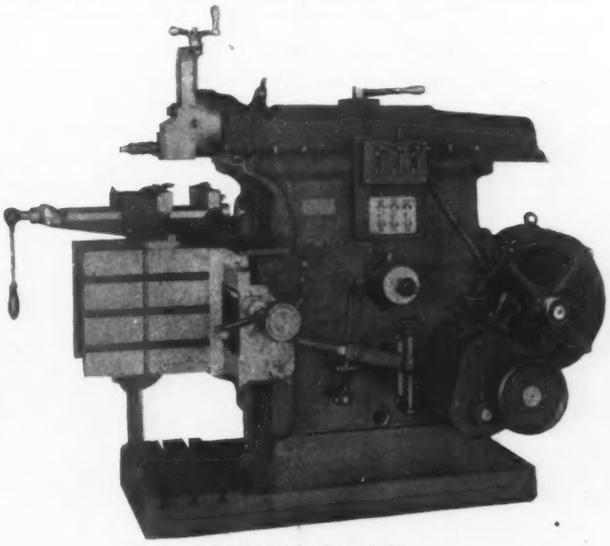
The accompanying illustration shows the electric washer made by the "1900" Washer Company, of Binghamton, N. Y. The

COMBINED WASHER AND WRINGER.

machine consists of a wooden tub with a wringer attached, and both are arranged to be driven at will by a small motor attached to the wash-tub support. In this washer the clothes are held still while the water and soap and motion of the tub back and forth do the work. In this way delicate fabrics are not injured. The tube is driven through an upright shaft connected at the lower end to a crank which moves back and forth the little rod which is fastened to the pivot under the center of the tub bottom. This crank and rod are for the purpose of swinging the tub part way round, and then back during washing. The shaft is driven by a belt which runs from the motor to the driving wheel at the top of the shaft. This driving wheel is connected to the shaft by bevel gears, which make the shaft turn to move the tub or the driving wheel can be connected to another set of bevel gears to turn the wringer. Shifting of the power from the washer to the wringer is done by the aid of a small lever. Substantial springs are used in assisting the motor in imparting to the tub the erratic motion necessary in the washing operation. The machine is very simple in operation and has found an extensive use.

Motor-Driven Shaper.

A motor-driven shaper which has been designed especially to meet modern requirements is shown in the accompanying engraving. In comparison with former machines the shaper is larger and heavier in the working parts in order to obtain the fullest possible benefit from the new high-speed cutting steels. The shaper is connected to the motor by means of a silent chain enclosed in a guard. In connection with the advantages of quick speed change enjoyed through the use of the motor, a



MOTOR-DRIVEN SHAPER.

clutch and brake device is furnished for instantly stopping the machine without stopping the motor. This feature not only saves time in setting, adjusting and inspecting the work, but also saves wear and tear on the motor from frequent stopping and starting, the latter running continuously while the job is in the machine. The shaper has been designed and built by Gould & Eberhardt, Newark, N. J., the motor being of the induction type supplied by the Allis-Chalmers Company, Milwaukee, Wis.

Rail-Bond Protector and Auxiliary Bond.

The Chase-Shawmut Company, of Newburyport, Mass., has placed upon the market the Shawmut rail-bond protector, a device designed to protect both the soldered and plug type of bond from being sheered off by wagon wheels, damaged by paving stones or ballast, injured by track crews and to discourage theft. The protector is made of heavy steel securely fastened to the rail by means of the bolts which hold the fish-plate in place, thus making its application of the simplest nature. It is of such shape as to allow inspection without re-

moval of fishplates, and can be applied to either new or old rails without impeding traffic.

As a means of increasing the efficiency of plug and pin bonds the same company has devised the Shawmut auxiliary bond. This consists of a copper cap with a rail-engaging flange filled with solder, which is heated and applied to the end of the bond. By giving additional contact surface the resistance at the rail joint is reduced to a minimum. It is stated that a recent test made with auxiliary bonds applied on new plug bonds just installed showed a gain of over 15 per cent in conductivity.

Corrugated Mirror Reflectors.

The National X-Ray Reflector Company, 247 Jackson Boulevard, Chicago, has recently added two important reflectors to its line. One of these, No. 700, shown in Fig. 1, is a deep cone reflector of the concentrating type. The distribution of light from this reflector with a 16-cp incandescent lamp is shown in

FIG. 1.—CONE REFLECTOR.

Fig. 2. This reflector is similar to reflector No. 696, which this company has been manufacturing for a number of years, and which is in extensive use. The new reflector is blown in a mold instead of being hand-formed, and hence will be uniform in shape, size and corrugations. The corrugations are of a design which largely eliminate the light and dark streaks which are so likely to be found on a surface illuminated from mirrored reflectors. The conical reflector produces a fairly broad concentrated beam of light. While the concentration is not as extreme as can be produced by some conical mirrored and smooth opal reflectors, the manufacturers believe that for most purposes where a reflector of this character is needed, an extreme concentration over a very small area is not as desirable as a concentration which will give 90 candle-power over a considerable angle, as does this reflector. On account of the efficient character of the reflecting surface, this reflector shows a much higher efficiency than any of the tin or aluminum reflectors, or the common green-plated opal desk shade. It is claimed to have a more durable reflecting surface than ordinary built-up plate-mirror reflectors, and can be used in a great many locations where the streaked light cast by the older forms of mirrored reflectors would prohibit their use. This conical reflector is suited to use over desks, jewelry counters, display tables, show windows, billiard tables, and, in fact, all places where an opaque concentrating glass reflector is desirable. It

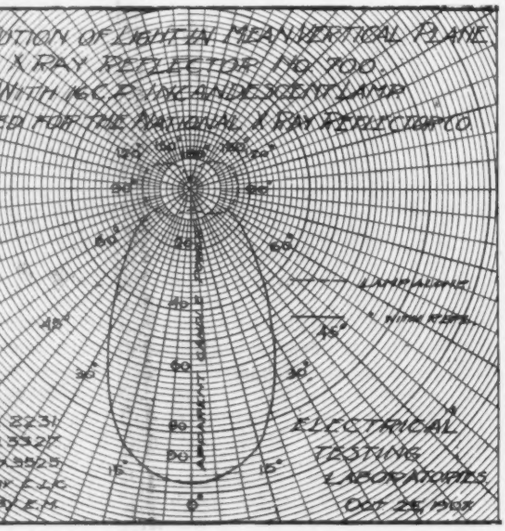

DISTRIBUTION OF LIGHT IN MEAN VERTICAL PLANE
X RAY REFLECTOR NO 700
WITH 16 C.P. INCANDESCENT LAMP
TESTED FOR THE NATIONAL X RAY REFLECTOR CO.
ELECTRICAL
TESTING
LABORATORIES

FIG. 2.—DISTRIBUTION OF LIGHT FROM CONE REFLECTOR.

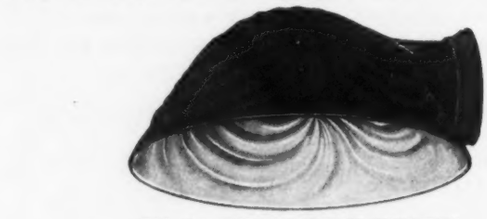


FIG. 3.—HALF PARABOLIC REFLECTOR.

gives notably excellent results for billiard-table lighting, five lamps being hung over a table, one in the center and one over each corner. The distribution of light is such as to give a strong, uniform illumination over the table with this arrangement without allowing the light to shine in the eyes of the players.

In Fig. 3 is shown a new half-parabolic reflector No. 525, the distribution of light from this reflector in two planes with a 16-cp lamp being shown in Fig. 4. This reflector is suited for use over desks and blackboards, or any place where a half reflector is most properly and conveniently employed.

The silvering is applied to both of the above reflectors on the outside, and over this is placed an elastic enamel paint. The manufacturers claim great durability, and to verify these claims cite cases where these reflectors have been in continuous show-window service for five years without noticeable blackening.

In substantiation of the makers' claims for high efficiency of the reflecting surface, tests are cited which were made by the

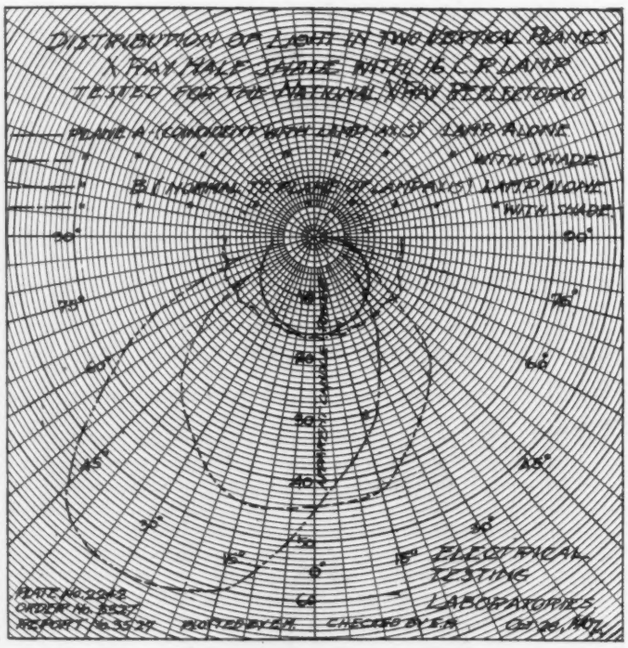

DISTRIBUTION OF LIGHT IN TWO VERTICAL PLANES
X RAY HALF REFLECTOR WITH 16 C.P. LAMP
TESTED FOR THE NATIONAL X RAY REFLECTOR CO
ELECTRICAL
TESTING
LABORATORIES

FIG. 4.—DISTRIBUTION OF LIGHT FROM HALF PARABOLIC REFLECTOR.

Electrical Testing Laboratories under the supervision of a committee of the Association of Edison Illuminating Companies, in the summer of 1907, in the auditorium of the New York Edison Company, the results of which have been published in the technical press. Three tests made with the room illuminated by 16-cp lamps hung pendant in deep conical reflectors similar to the No. 700, which were described, showed that from 88.3 to 79.6 per cent of the total amount of light generated by the lamps was delivered on a plane 30 in. from the floor, a higher efficiency than shown by any of the other lamps.

Motor-Driven Hydraulic Press.

An interesting incident showing a new advantage of motor drives turned up recently. A large Ohio paper mill ordered several engine-type generators of the Northern Electric Manufacturing Company, Madison, Wis. Through an oversight of the customer in his specifications, neither the engine builder nor dynamo manufacturer had made provisions for mounting the armature. When this was discovered after erecting operations had begun, it was found that no jobbing shop was in a position to handle a force-fit of about 150 tons. Accordingly the Northern Electrical Manufacturing Company shipped from its works one of its motor-driven hydraulic presses, with necessary rigging for pressing the armature on the shaft. A small generator was rigged up to furnish current and the job of pressing completed in short order. Had not the portable motor-driven outfit been available, considerable delay would have been necessary, and much expense in shipping the armature and shafts to the engine builder's factory for mounting.

Lundell Fan Motors.

The Lundell single field-coil fan motors illustrated herewith, made by the Sprague Electric Company, are made for 12-in. and 16-in. fans, and are provided with a universal joint so that the fan motors may be placed in various positions. A

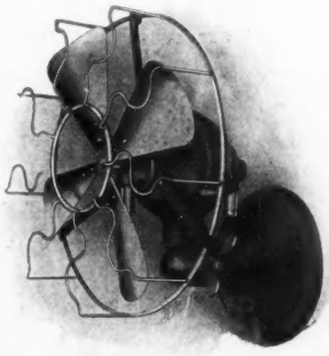


FIG. 1.—BRACKET FAN.

self-feeding oil cup, which is independent of the bearing, is a feature of the construction. A speed-regulating rheostat permitting three widely varying speeds is mounted in the motor base. The form of construction employed in making the fan blades renders it impossible for the blades to become loose. The importance of perfection in small details has constantly

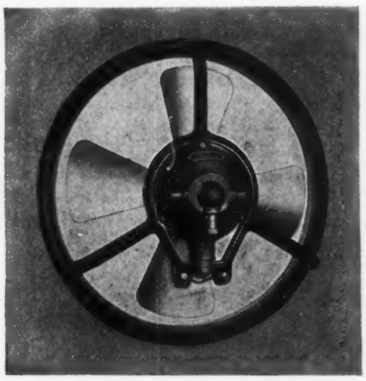


FIG. 2.—EXHAUST FAN.

been kept in mind, so that the details of the 1908 fan are only such as previous experience has shown to be the best for the purpose. It is only in minor details that the fan motor differs from that of previous years.

The midget exhaust fans, one of which is shown herewith, have their motors mounted by means of brackets so that the blades revolve in the opening made in a board or other suitable material cut to fit the top or bottom of a window. A small wall rheostat is furnished with which the speed of the motor can be suitably controlled. The motors are designed for 115- and 230-volt circuits; the 12-in. fans taking 0.43 and 0.25

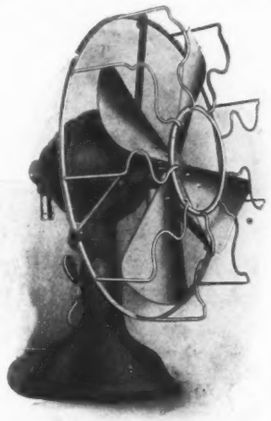


FIG. 3.—UNIVERSAL-JOINT DESK FAN.

ampere, respectively, and the 16-in. fans requiring 0.77 and 0.40 ampere, respectively. The motors are all given a high-grade finish, which has contributed much to their popularity.

General Electric Fan Motors for 1908.

General Electric fan motors for 1908 are somewhat plainer and more simple than those of previous design, but possess the same high degree of efficiency, speed, control and reliability. The most noticeable feature in connection with the direct-current desk motors is the universal joint with which they are equipped, and by means of which a desk motor may be instantly transformed into one of the wall-bracket type, or vice versa, without the aid of tools. Desk fans, as usual, are furnished in all different types for standard voltages and frequencies. Both direct- and alternating-current fans of the desk type are fitted with 12-in. or 16-in. blades. These, with the bracket-type fans of the same design and sizes, are available for all classes of service. Quite recently the use of the fan

FIG. 1.—ALTERNATING-CURRENT DESK FAN.

motor in the cold-air pipe of the hot-air furnace has been exploited as an economical addition to the heating system. The square frames of the exhaust-fan types might readily be adopted for this purpose, and a permanent installation be made. The illustration of the exhaust fan indicates the method of mounting. This type of fan is useful in both private and public kitchens, in restaurants, lavatories and stores where a permanent method of ventilation is desirable.

The design of the ceiling and column fans, here illustrated, is radically different from that of the 1907 type. The general appearance is very simple and the motor body is much thinner,

which results in a corresponding decrease in weight, while the improved ball-bearing renders the operation of the motor practically noiseless. These motors are fitted with four wooden blades having a 52-in. sweep, which suits them for the cooling of large areas without disagreeable draughts. The alternating-current ceiling fans are for operation on 60-cycle circuits, at 100-110, 112-120 and 220 volts. They are furnished in both plain and ornamental finish. The direct-current ceiling fans are for operation on circuits of 115 and 230 volts.

The speed variation of the alternating-current fans is ob-

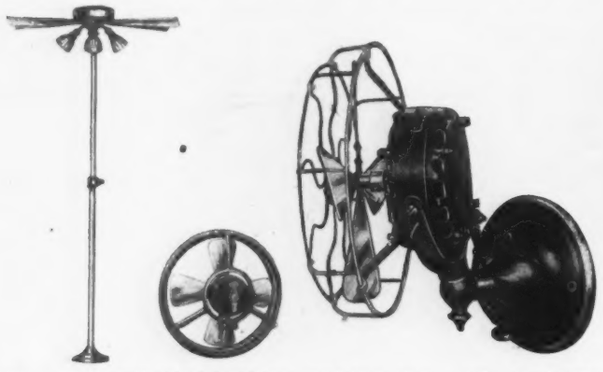


FIG. 2.—ALTERNATING-CURRENT COLUMN FAN. FIG. 3.—DIRECT-CURRENT EXHAUST FAN. FIG. 4.—ALTERNATING-CURRENT WALL FAN.

tained by a six-point regulating switch and reactive coil. In this way the General Electric standard desk or wall-bracket type is of well-nigh universal application, since it may be operated on slow speeds for the office desk or home, and on the higher speeds for stores and halls. Similar speed regulation is obtained in the direct-current type of desk and wall-bracket

FIG. 5.—DIRECT-CURRENT CEILING FAN.

fans by a self-contained four-point switch and indestructible resistance, giving three speeds.

All the various types of fan motors which have been mentioned are made in standard commercial sizes, and for any commercial voltage and frequency. In general, the standard finish is black with brass trimmings, but this may be varied to meet special conditions, and fans can be decorated to match office fittings or to harmonize with the hardware in private dwellings.

Emerson Fan Motors.

The Emerson Electric Manufacturing Company offers a complete line of alternating-current induction desk, ceiling and column fans in all standard sizes and types; also a line of direct-current series desk fans. All types of desk fans are convertible into bracket fans without extra parts.

The Emerson medium-speed desk fan shown in Fig. 1 is a two-speed swivel and trunnion fan, made in 12- and 16-in. sizes. In addition, an Emerson slow-speed 12-in. two-speed swivel and trunnion residence-type desk fan is offered, equipped with six blades, as shown in Fig. 2. This fan is considerably more quiet than the medium-speed type, and is intended especially for home use.

The line of "Trojan" induction desk fans offered by the

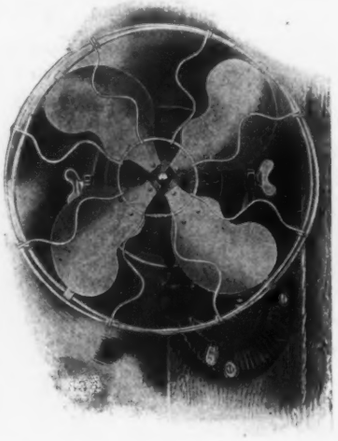


FIG. 1.—CONVERTIBLE FAN.

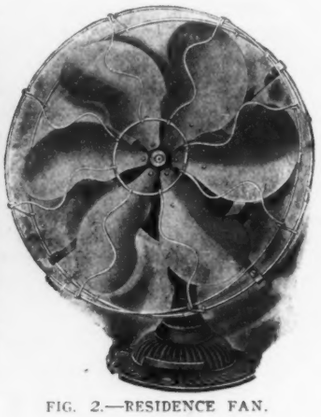


FIG. 2.—RESIDENCE FAN.

Emerson Company consists of the same sizes and types as above mentioned, but Trojan fans are equipped with triangular blades instead of the patented Parker blades used on the Emerson fans shown in Figs. 1 and 2. All induction desk fans

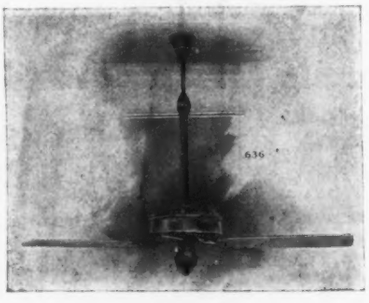


FIG. 3.—CEILING FAN.

offered by the Emerson Company have a special automatic starting device and industrial-motor form of field winding, resulting in high efficiency.

Emerson alternating-current ceiling fans are made in two styles—a high-speed four-blade, and a slower-speed two-blade

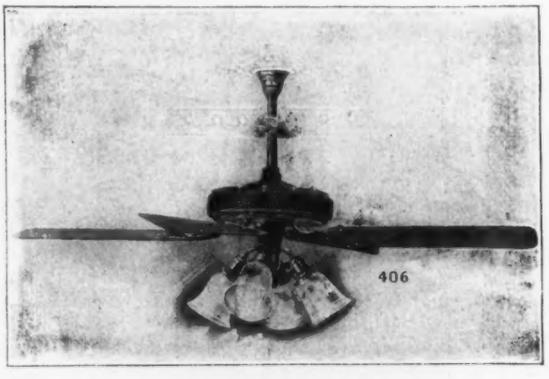


FIG. 4.—CEILING FAN WITH ELECTROLIER.

type. The latter is intended especially for residence use, small offices, etc. Emerson fans are finished in ornamental oxidized copper, furnished with adjustable hanger, and are arranged to run at three speeds.

"Trojan" alternating-current ceiling fans, also made by the Emerson Company, are similar in internal design to those

known as the Emerson, and are likewise made in two- and four-blade styles. Trojan fans are finished more plainly in black japan, are furnished without hanger rods, and have only two speeds.

In direct-current desk fans, the Emerson Company offers 12- and 16-in., three-speed swivel and trunnion desk styles, convertible into bracket styles. These are medium-speed types suitable for stores or large offices where maximum breeze is desired. A six-blade residence type, direct-current desk fan (a new type) is also offered this year, with a maximum speed of approximately 1100 r.p.m.

Alternating-Current "Standard" Fans.

The accompanying illustrations show several models of alternating-current fans which the Robbins & Myers Company, of Springfield, Ohio, is placing on the market this year for the first

FIG. 1.—ALTERNATING-CURRENT CEILING FAN.

time, to supplement its line of direct-current fans, each model of which has been previously described in these pages.

The alternating-current ceiling fans carry blades of 57-in. sweep, which can be run at 200, 150 and 100 r.p.m., according to

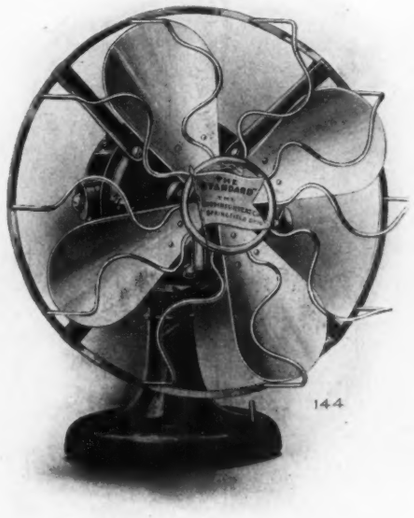


FIG. 2.—ALTERNATING-CURRENT DESK FAN.

the position of the switch, which also starts and stops the fan. The motor is provided with a casing directly below the fan blades, which is tapped to receive an electric-light fixture should it be desired to make the combination of electrolier and fan. Owing to the large diameter of rotor necessary with ceiling-fan motors of this type, and the consequent weight of the rotor, ball-bearings are used and are provided with automatic lubrication, facilitating starting and increasing the efficiency of the motor.

The alternating-current desk fans are provided with a switch for starting and stopping, and giving two running speeds of approximately 1300 and 1500 r.p.m. for the 12-in., and 1200 and 1500 r.p.m. for the 16-in. fans. They are convertible from desk to bracket type by the use of an adapter, and without disturbing the wiring of the motor, so that it is no longer necessary for a

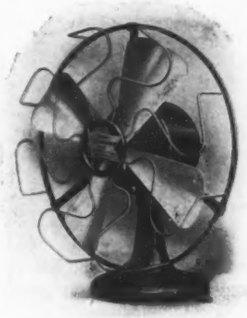


FIG. 3.—9-IN. DIRECT-CURRENT AND ALTERNATING-CURRENT DESK FAN.

dealer to carry in stock both desk and bracket fans. They are provided with the usual swivel and trunnion support which allows of the adjustment of the direction of the air current.

The extension of lighting mains into the residence districts has created a demand for a new type of fan—one which is intended for use principally in residences and small offices. This is the 9-in. fan, which is illustrated here for the first time. For this class of service the 12-in. fan has been found more powerful than necessary, and the smaller fan is finding a ready use. It is not designed as a low-priced fan, but is simply smaller in size and is made as neat and artistic as possible, and special attention has been given to making it cleanly, durable and silent running, thereby adapting it to its particular field. It is provided with the usual switch in the base, giving speeds of approximately 1000 and 1700 r.p.m. This fan forms a notable exception to the rule in favor of the induction type of motor given above, in that it is provided with commutator and brushes,

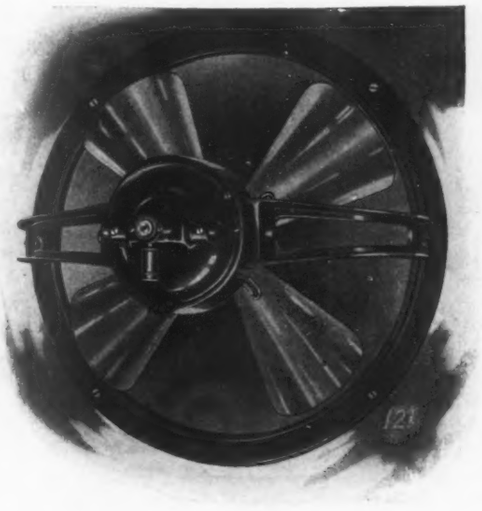


FIG. 4.—EXHAUST FAN.

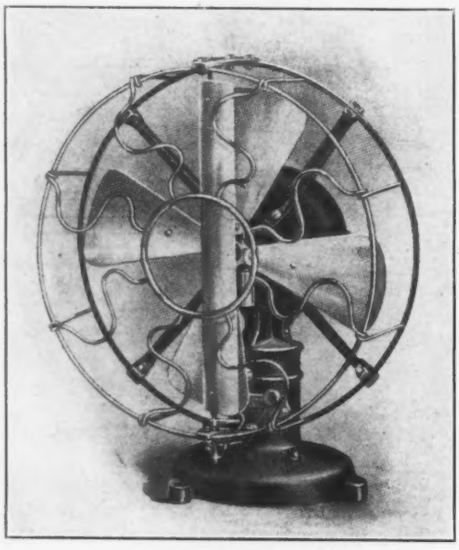
and is a series-wound motor. The 9-in. fan is also supplied wound for 110 and 220 volts, direct current.

For the last few years this company has had on the marke

two sizes of small exhaust fans made by adapting its 12-in. and 16-in. direct-current desk-fan motor bodies to exhaust-fan service. In addition, it is now furnishing the 12-in and 16-in. alternating-current induction type motors mounted in the same way. The accompanying illustration shows the direct-current model, which is very similar in appearance to that for alternating current.

Colonial Fan Motors.

The Colonial Fan & Motor Company, of Warren, Ohio, builds a line of direct-current desk and ceiling fan motors, which though they follow the same general design as last season's output, embody some minor improvements. One type of desk-fan motor is provided with swivel and trunnion movements, while two other types have swivel motion only. The oscillating fan built by this company is shown herewith. The rotating part travels on a tempered ball-bearing so as to limit friction to a minimum. The vane which operates the mechanism is located inside the fan guard where the air from the fan impinges on it.



OSCILLATING DESK FAN.

The actuating device is simple and positive. Collector rings and brushes placed above a two-speed switch in the base of the fan make it possible to omit the customary flexible lead connections. The motors are designed for 110- and 220-volt circuits, and are fitted with 12-in. and 16-in. fans. For railway and storage-battery service, fans are built for 25, 30, 60 and 80 volts. Two types of ceiling fan, each with a 60-in. sweep, are built. Both types are built for five different voltages, but only one type is capable of speed adjustment. The exhaust fans built by the company are of the enclosed, series-wound type, and are equipped with a speed controller, fan runner and supporting ring. The motors are designed for 110, 220 and 500 volts.

Western Electric Fans.

The Western Electric Company presents for the season of 1908 several additions and improvements in its comprehensive line of fan motors and exhaust fans, while retaining the many good features which have proven their excellence in the past.

The Universal type direct-current fan motor is now put on the market in two sizes, of 12 in. and 16 in. It operates on voltages of 110 or 220 and has three speeds. This season's model is fitted with an improved oil thrower, which absolutely prevents any oil getting out of the bearing housing. This feature will meet with hearty approval from fan users who have experienced the annoyance caused by the sparking of dirty commutators. The same fan can be used as either desk or bracket type by the simple adjustment of a thumb-screw.

The Zero type, direct-current fan has an improved design of commutator and operates at 110, 220 or 500 volts. The 16-in. size has a guard of new design, and both the 12-in. and 16-in. fans have three speeds.

An entirely new fan motor is presented this year for use in telephone booths and similarly confined places which reach an

FIG. 1.—UNIVERSAL FAN.

oppressive temperature during the warm season, and where the use of a large fan is not only unnecessary, but expensive. It has an 8-in. fan, and is provided with spring suspension to

FIG. 2.—ZERO DESK FAN.

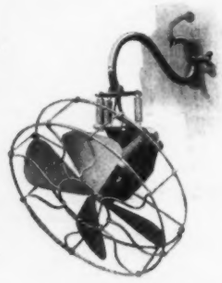


FIG. 3.—TELEPHONE-BOOTH FAN.

overcome vibration. Either direct or alternating current at 110 volts can be used, and no special resistances or alternators are necessary in changing from direct to alternating current.

A new addition to the line of alternating-current fan motors is the Victor, which is supplied in both the ceiling and the desk type. The desk type is adjustable for use either as a desk or wall fan, and operates at 110 or 220 volts. A wide range in frequency is assured, as the motors are built to run on from 25 to 133 cycles.

The Western ceiling fan is now put out in two types, one operating at a single speed and the other having three speeds. The one-speed type is provided with a snap switch. In addition to the regular finish of black enamel, this type may also be

FIG. 4.—STANDARD CEILING FAN.

FIG. 5.—EXHAUST FAN, WITH TYPE E MOTOR.

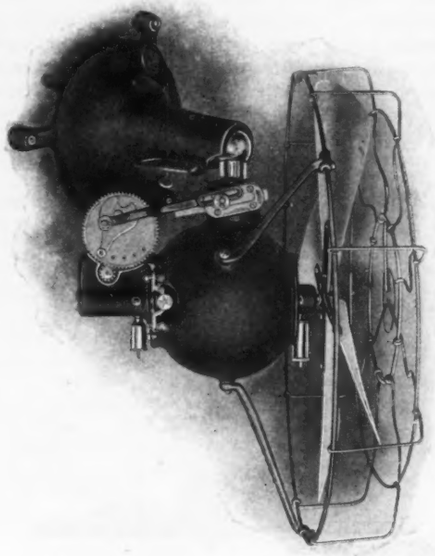
given an oxidized copper finish. The voltages are 110, 220 or 500.

An improvement in Western Electric exhaust fans which merits special mention is the use of new types of motors.

Type "I" motors are used on the 18, 24, 30 and 36-in. outfits, and Type "E" motors on all larger sizes. Both of these machines are standard types of industrial motors.

Eck "Hurricane" Oscillating Fan Motor.

The accompanying illustration shows the "Hurricane" oscillating fan motor built by the Eck Dynamo & Motor Company, of Belleville, N. J. The motor is provided with universal adjustment and a positive mechanical device is used to produce the oscillatory motion. A rheostat, by means of which three speeds may be obtained, is provided in the base of the pedestal.



"HURRICANE" OSCILLATING FAN.

The oscillating device is adjustable so that the motor may remain stationary or the oscillations reduced to meet requirements. The transmission device operates in an oil case, insuring positive lubrication and durability. The brush holders are of the well-known Eck type, and square brushes are used. The latter are held firmly in place and have a positive feed, so as to render them noiseless in operation as well as sparkless. The motors are equipped with 12-in. and 16-in. fans, and are designed for operation on 115- and 230-volt, direct-current circuits.

Bates Direct-Current Fan Motors.

The line of direct-current fan motors built by the D. L. Bates & Brother Company, of Dayton, Ohio, includes many

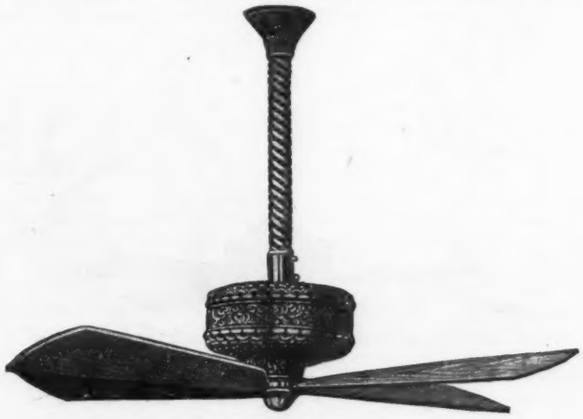


FIG. 1.—DIRECT-CURRENT CEILING FAN.

types of ceiling and desk fans. All of the ceiling fan motors except one are built for 110, 167, 220, 250 and 500 volts, and the energy consumption is stated to be 90 watts on a 110-volt circuit, motors wound for higher voltages consuming power in proportion. One type of ceiling fan is shown herewith. Some of the ceiling fans are fitted with incandescent lamps, which revolve when the fan is in motion, although the wiring is independent of the motor circuit; the column fans are similarly equipped. The desk fans are built in pedestal, bracket, trunnion and universal types. The universal type,

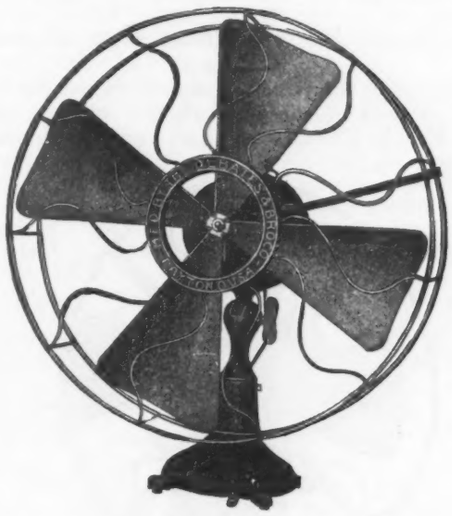
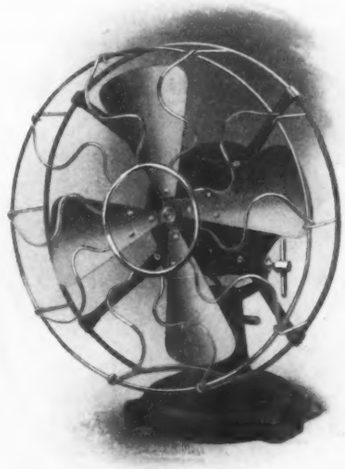


FIG. 2.—UNIVERSAL DIRECT-CURRENT DESK FAN.

shown in Fig. 2, has a 20-in. fan, the other motors being equipped with 12- and 16-in. fans. The desk fans are designed for operation on 110- and 220-volt circuits, and are provided with a base rheostat giving three speed adjustments.

Peerless Direct-Current Fan Motors.

Technically considered, the fan motors built by the Peerless Electric Company, of Warren, Ohio, continue much the same as in previous years. Only two types of ceiling fans are offered this year, the working parts of which are identical. The swivel and trunnion desk fans still retain the features for converting



DESK FAN.

them into bracket fans by adjusting a thumb-screw at the trunnion, and the entire interior of the fan motors is japanned so as to prevent rust when operating in damp locations. The motors are equipped with standard-sized fans, and are designed to operate from 110- and 220-volt circuits. The oscillating fans are fitted with a shifting vane inside the fan guard and the reversals of oscillation are cushioned by the air from

the blades. The fan body rotates on a ball-bearing, and the brackets that support the actuating vane are rigidly fastened to the guard. The electricity is transmitted from the main circuit through carbon brushes to collector rings mounted on the bearing shaft. The column and ceiling fan motors have speeds of 110, 170 and 220 r.p.m. The current required varies from one ampere on 110 volts to 0.23 ampere on 500 volts; the motors are also designed for 170, 220 and 250 volts.

The 1908 Westinghouse Fan Motors.

Changes do not always mean improvement, and the fan that embodies the greatest number of changes this year may still be in need of the greatest number of improvements next year.

FIG. 1.—DIRECT-CURRENT FAN.

In the case of the fan motor, no new principle has lately been discovered, and the fan motors of 1908 which embody any radical improvements show at the same time that there was room for improvement. Westinghouse fans for 1908 show very slight modifications over the 1907 models for the very good reason that the 1907 fans needed very slight modifications. The design of Westinghouse fans is the work of experienced engineers who make a specialty of this branch of the electrical business, and the product that is offered to the public is thoroughly tested and tried out before it is put on the market. The result is a line of fan motors giving maximum air current for the minimum electric current.

FIG. 2.—WALL BRACKET FAN.

The motors themselves are as much Westinghouse in their characteristics as the motors of large capacity made by the Westinghouse Electric & Manufacturing Company. This means that they are made of the best materials and thoroughly tested before leaving the works, and that they will run for many seasons without expense for repairs.

In comparison with the motor, the blades seem to be a simple matter, but upon them depends both the current consumption and the volume of air set in motion, which is the final test of the apparatus. Much attention has been given to the design of the blades of the desk and wall type to get the most effective movement of the air, and the result is a blade that moves the greatest possible quantity of air in the form of a solid cone so as to eliminate waste of energy in useless eddies. Consequently, the saving in current for the volume of air moved is marked when comparison is made with a fan whose blades give a strong current in front of the ends and a weak current in front of the center. The 12-in. alternating-current Westinghouse fan requires one-third less current than a 16-cp incandescent lamp, and the 16-in. alternating-current fan one-third less than two 16-cp lamps. The 16-in. direct-current fan shows about the same economy as the alternating current, while the 12-in. direct-current requires only half as much current as a 16-cp lamp.

FIG. 3.—DIRECT-CURRENT CEILING FAN.

Adding to the low cost of operation the fact that a fan motor will operate several years with little or no cost for repairs, and at a low first cost, it becomes an article that is well within the means of every user of electric light whether for commercial or domestic purposes, and is removed from the list of luxuries and added to the list of necessities.

A prominent feature of Westinghouse fan motors is their comparatively noiseless operation. Special 8-in. blades, which run absolutely quiet, can be furnished with 12-in. motors, where fans are desired for sickrooms. With these blades the motors consume far less energy and, at the same time, deliver as much air as many 12-in. fans of other makes. Equally successful results may be had by using 12-in. blades on 16-in. motors.

FIG. 4.—ALTERNATING-CURRENT CEILING FAN.

The Westinghouse line of fans for 1908 embraces all the different types; namely, desk, wall bracket, ceiling, ventilating, floor and counter, for both direct- and alternating-current circuits, and for all commercial voltages.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—With the advancing season, the jobbing trade shows a considerable increase, but the wholesale trade remains quiet and the retail trade very quiet. Collections are still slow and the lack of speculation is reflected in the reduced number of bank clearings. In the iron and steel trades the buying of steel rails is the chief development of the week, a number of railroads having placed considerable orders for the finished steel. The leading steel company is now operating a trifle in excess of 50 per cent of its rolling capacity, as compared with a ratio of less than 30 per cent a few months ago. In the textile manufacturing interests it is reported that the output is about three-fourths of the normal. The winter wheat crop is in excellent condition and the export of cereals continues heavy. The demand for structural material is fair and business for February was considerably in excess of that of January. *Bradstreet's* reports 254 failures for the week ending Feb. 27, against 326 last week, as compared with 194 for the same week in 1907 and 180 in 1906. An encouraging increase in orders, with growing activity, is reported for the last week, by the larger electrical manufacturing concerns, particularly in the export line. The export demand for bronze rod and copper wire is excellent and a number of new contracts of considerable importance for installations in foreign countries are under consideration. In certain foreign sections where the panic in the United States has been slow in reaching, the electrical business is just beginning to show the effects. "Chili is bankrupt and Peru little better," said an agent for a well-known electrical exporting firm, "but from other parts of the world the reports indicate that the business prospects for the next six months are excellent." The same firm says that large orders have been received from Japan, and another foreign contracting firm reports having received important specifications and inquiries from China and South America. The progress of the Westinghouse Company toward a final settlement of its financial difficulties is an encouraging feature and the increasing activity in all electrical lines furnishes some basis for the large amount of bull talk on copper metal and copper shares which has been much in vogue in Wall Street of late. The repair business and supplying of large plants prefer in such times of stringency to repair old machinery and take chances, rather than create additional fixed capital, but a number of specifications and inquiries in increasing volume have been received during the last week by dealers in electrical supplies both large and small.

BUTTE ELECTRIC & POWER COMPANY.—President C. W. Wetmore, of the Butte Electric & Power Company, of Butte, Mont., reviews the work of the corporation for the past year as follows: "During the year 1907 the company has acquired the electric-lighting properties at Livingston, Mont., including a hydro-electric plant and water rights upon the Yellowstone River near Livingston; has completed the second hydro-electric plant on the Madison River, an installation of 12,000 hp; has extended the power transmission lines of the Madison River plants to the plant at Livingston, thus uniting the powers of the Madison River and the Yellowstone; has installed a new central steam-heating station at Butte, and has made other important improvements upon its various properties. The properties of the company are in excellent condition, and the operating efficiency and earning capacity are greater than ever before in its history. Besides its reserve plants, the company has now installed hydro-electric generating capacity aggregating 20,000 hp as follows: Upon the Madison River, 15,000; upon the Big Hole River, 4000; upon the Yellowstone River, 1000. Through its subsidiary companies, the company is in possession of water rights which will admit of the development of from 30,000 to 40,000 additional hydro-electric horse-power at unusually low cost. During the year 1906 an exhaustive examination on behalf of the company was made by competent experts of the water-powers of Montana and of the present and prospective market for hydro-electric power, and the conclusion reached that the demands for such power would keep pace with the probable prospective development and would ultimately exhaust the entire water-power capacity of the state. The undeveloped rights of the company are, therefore, believed to be of great value."

AMERICAN ELECTRICAL MACHINERY.—Reporting on the State of Jalisco in Western Mexico, Special Agent Arthur B. Butman states that American electrical machinery has the best reputation there, although the Germans are making strenuous efforts to obtain the Mexican trade in electrical devices. The mining machinery used in the mining districts of that region is, for the most part, of American manufacture. The American manufacturer in the case of mining machinery at least, has studied the needs of its customers, the requirements of packing and shipping, and consequently the American machinery has the higher reputation. In order to be carried over the trails in a convenient manner, most of the machinery is shipped in sections.

SPANISH ELECTRICAL CONSTRUCTION.—In the issue of the *Gaceta de Madrid* of January 21 appears a text of a Spanish decree, granting a concession to Don Luis Montesino y Espartero for the construction of an electric tramway called the Tranvia Transurbano de Madrid, from the station of Mediodia to the north station at Madrid. The Jan. 23 issue of the same paper announces that the Compania del Ferrocarril de Langreo y del Sindicato Verina Abono-Musel has been authorized to construct the necessary works for the production of electric power in the port of Musel, Spain.

THE JACOBSON MACHINE MFG. CO., Warren, Pa., states that so far it has not experienced any slack-up in orders received or business done, and that it has not laid off any men nor reduced wages since the commencement of the period of general business depression. An office has recently been opened at Atlanta, Ga., to meet the rapidly growing Southern demand for the types of gas and gasoline engines manufactured by the company.

TURBINES IN NEW HAVEN.—The United Illuminating Company, New Haven, Conn., has placed orders for two 400-hp steam turbines, which will be installed in the company's plant on George Street. The new equipment will be used in connection with the extension of incandescent lighting service in the residential districts of the city. The company has recently increased its capital stock from $1,000,000 to $1,500,000.

THE ELECTRICAL MANUFACTURING COMPANY, 926 Lafayette Street, New Orleans, has been incorporated with a capital of $25,000 for the manufacture of a high-grade line of panels and switchboards, steel outlet boxes, etc. The officers are Geo. W. Logan, president; Warren B. Reed, vice-president; E. S. D. Logan, secretary and treasurer, and Lyman C. Reed, manager.

THE WESTINGHOUSE LAMP COMPANY'S factory at Bloomfield, N. J., is now in operation, and arrangements are being made to concentrate there all lamp manufacturing. The capacity of the new plant is about 15,000,000 lamps annually. During the receivership, which ended March 1, there was no cessation of work in completing the factory and in turning out lamps.

NEW NOARK LINE.—The Johns-Manville Company has in preparation a new line of Noark service and subway boxes, embracing a large variety of types for the various classes of service. The new line will be placed on the market in about a month, when the company will issue its spring catalog.

MEXICAN RAILWAY PLANT.—In the Jan. 7 issue, the *Mexican Diario Oficial* contains the text of a contract entered into by Sr. José Sarinana, representing the Compania del Ferrocarril Electrico de Lerdo a Torreon, for the construction of a line between the states of Durango and Coahuila.

ELECTRIC SUPPLIES.—From the Far East, an American consular officer reports on the possibility of selling American supplies in that territory. The Bureau of Manufactures, at Washington, D. C., will furnish further particulars to applicants.

THE WEEK IN COPPER.—The features of the week in the copper market were continued heavy shipments of metal abroad, the activity exhibited by copper stocks and the resumption in part of the operations by the Amalgamated properties in Butte. It was believed that the foreign movement was nearly ended, but exports for February were 24,640 tons, or a total of 57,659 tons since the beginning of the year as compared with 26,213 tons for February, 1907. There are those who believe that Europe is still capable of taking an indefinite amount of American copper at the present prices. The resumption of operations in Butte seems hardly to be justified by the conditions at home and abroad. Approximately 175,000,000 pounds a year will be added to the copper output by the opening of the Amalgamated mines, and this in the face of the fact that there has been little increase, if any, in the home demand for the metal. It is known that the greater part of the foreign shipments has not gone into consumption, and it is thought that the same thing will happen which took place several years ago, when, under similar conditions, a great quantity of the metal was shipped to China, only to be held there and thrown back on the home market when the price of copper had risen. A dispatch from Butte states that John D. Ryan, managing director of the Amalgamated Copper, said in reference to the copper situation: "There has been a very considerable change for the better in the market for the metal, in that the sales for European shipment have been very large within the last few weeks. There is no accumulation of copper unsold that is worth considering. The American consumption is light compared with the last few years, and the large sales made during the last six months have been mostly for export, but we are in hopes that by the time the increased products resulting from a resumption of operations will have reached the market, which will be in three or four months, the American demand will have increased sufficiently to take up the increased production." At present there are ten copper mines in operation which can yield a yearly total of 150,000,000 pounds at a cost of ten cents or less. In ordinary times the American consumption is about 50,000,000 pounds monthly, and in 1907 it was about 70,000,000, but at the present rate the monthly consumption is placed at less than 20,000,000 pounds. Persistent reports of late have been in circulation to the effect that B. B. Thayer is to succeed Henry H. Rogers as president of the Amalgamated Copper Company and there has been much talk of some sort of deal between the Amalgamated Copper Company and certain mines in Butte and others in Nevada and Utah. The Carro De Pasco Copper Company has been incorporated with a capital of $60,000,000 to mine copper, gold and other ores. Closing prices on the Metal Exchange on Monday were:

Lake	12½@12¾c.
Electrolytic	12⅜@12⅝c.
Castings	12¼@12½

The London market was as follows:

	Noon.	Close.
	£ s. d.	£ s. d.
Standard copper, spot	57 2 6	57 7 6
Standard copper futures	57 12 6	57 17 6
Market	Weak.	Firm.
Sales of spot		300 tons
Sales of futures		900 tons

Extreme fluctuations for the year:

	Highest.	Lowest.
Electrolytic copper, spot	13¾	12¼
Lake copper, spot	13⅞	12⅜
Casting copper, spot	13½	12⅛
London, spot	£64 5 0	£56 12 6
London, futures	64 10 0	56 17 6
London, best selected	67 10 0	61 0 0

WESTINGHOUSE COMPANIES.—Following the action of Judge Lanning, of the Circuit Court of Trenton, N. J., on Feb. 24, in ordering the New Jersey receivers of the Westinghouse Lamp Company to turn over the business to the company, Judge Ward in the United States Circuit Court of New York, on Feb. 27, on the application of George Whitfield Betts, Jr., counsel for the New York receivers, entered an order directing the New York receivers of the Westinghouse Lamp Company, Charles B. Hill, Edward H. Childs and T. W. Siemon, to turn over and convey back to the company all its assets and property, and to pay claims under $500, the company having made a settlement with its larger creditors. The report of the New Jersey receivers showed that the company from the time of their appointment, and up to the time of their discharge, had earned $50,000 net profit. The present liabilities of the company was given as about $300,000, and the assets $2,500,000, exclusive of good-will, patents, etc. Under the order, the company agrees to pay in full all creditors whose claims are less than $500. All creditors having claims in excess of that amount are to be paid January 1, 1909, with interest. The final date for receiving deposits of the creditors of the Westinghouse Electric Company was March 1, but the Committee for Readjustment has given notice that it has extended the period of limitation for deposits of obligations and claims until March 31. A meeting of the stockholders of the Westinghouse Electric & Mfg. Company has been called for April 29, to consider bond and stock issues, as suggested, in place of creditors committees. An officer of the Westinghouse Electric Mfg. Company, of Pittsburg, states that the company is employing about 60 per cent of its usual quota of men. Ninety-nine per cent of the creditors, representing $7,000,000 of liabilities of the Westinghouse Machine Company, have consented to the proposed plan by which creditors are to take, in payment of their claims, five-year notes, to be retired in annual installments out of earnings. In previous years the Westinghouse Machine Company has shown net earnings of over $800,000, so that in 5 years the company would be able to retire notes close to $4,000,000. The balance would then be refunded in permanent form. During the month of Feburary the business of the Westinghouse Machine Company showed marked improvement. Last week a number of good sized orders were received in the various departments, and as a result, there was greater activity in the shops in East Pittsburg than at any time since the financial depression began. Recent shipments from the works on export delivery are reported to include several large steam engines. One of these shipments, consisting of five 125-hp compound engines, was consigned to Takata & Company, the Japanese agents of the Westinghouse companies in Tokio, for delivery to a plant in Canton, China. Another compound engine of 500-hp capacity, also included in this shipment, was consigned to the same firm, for delivery to the Japanese Railway Company of Maisha, Japan.

EASTERN PENNSYLVANIA TRACTION SYSTEM COMPLETED.—The eight miles which form the connecting link in the electric traction system of the Pottsville Union Traction Company and the Tamaquah & Lansford Street Railway Company, now known as the Eastern Pennsylvania Railway Company, were opened on Feb. 27 and are now in operation. The completion of this part of the system gives a thorough service from Pottsville to Mauch Chunk, a distance of thirty-five miles, and affords a new route to New York, from Pottsville to Mauch Chunk by the electric road and thence to New York by way of the Lehigh Valley or Central Railroad of New Jersey. Work on the connecting link which has just been completed was begun on Oct. 1, 1907. These properties and various other lighting properties in that region were constructed and are under the management of the firm of J. G. White & Company. The entire traction system embraces 107 miles of urban and interurban roads. Power for the roads and the lighting systems is furnished by a new power station at Palo Alto, which has a capacity of 5000 horse-power.

THE SOUTHWESTERN MACHINERY & SUPPLY COMPANY, of Los Angeles, Cal., recently organized for the purpose of representing manufacturers of machinery and supplies exclusively in the fast growing Southwest, is under the management of Mr. Chas. L. Michod, who has been in this same business at St. Louis, and Havana, Cuba, for the past five years. The president of the company is Mr. J. Wallace, of 42 Broadway, New York, and Mr. Theo. G. Finley, of Los Angeles, is vice-president and treasurer. Considerable business with the Mexican trade is also anticipated, but Southern Nevada, Arizona and Southern California will be the principal territory covered.

THE ELECTRIC CABLE COMPANY OF BRIDGEPORT, CONN., will re-build a modern and larger plant to replace the works which were partially destroyed by fire on Feb. 18. A portion of the old plant which was not seriously injured is now running.

THE AMERICAN WELDING COMPANY has been formed to take over the welding business heretofore conducted by the Morton Iron Works, at Brooklyn, N. Y. The business will hereafter be located at Carbondale, Pa., and will be conducted on a much larger scale than in Brooklyn.

Financial Intelligence.

THE WEEK IN WALL STREET.—Extreme sluggishness prevailed in all the stock markets of the world during the last week, London particularly vying with Wall Street in dulness. In New York the business of buying and selling stocks was very nearly at a standstill and the entire sales for the week were less than the aggregate sales of many single days in the past. The public showed not the slightest inclination of touching the market, either for investment or speculative purposes, and practically all the trading that was done was by the professionals. At the same time the market showed a rock-like tendency, exhibiting the greatest firmness upon the receipt of bear reports that would have caused a sharp downward drive in the securities affected, in ordinary times. Such upward tendency as existed was centered in a few issues, conspicuous among which were the copper stocks. The bull movement in copper is attributed to the alleged improvement of conditions in the home metal market and the stronger showing of London copper stocks. Interborough-Metropolitan shares also moved sharply upward in anticipation of the benefits which it is expected will accrue to them from new and comprehensive financing. Steel stocks advanced out of proportion to the news of the receipt by the corporation, of substantial orders from the railroads. As exhibiting the perhaps somewhat illogical firmness of the market, the announcement on Thursday morning of a receivership for the National & Great Northern Railroad, a Gould property, caused not a ripple, although for some time past the Gould properties have been weak. The practical passing of the dividends by the Erie Railroad upon its first and second preferred stock, and the news of the withdrawal by Secretary Cortelyou of $35,000,000 from the National banks, are examples of numerous pretexts which the Street might have seized upon to make a bear market, but which were ignored. All of which seems to indicate that Wall Street, for the time at least, has ceased to concern itself with immediate causes and instead has in mind the fundamental factors which may affect the situation and which at present make for optimism. For the first time in history the gold bullion and bullion in the Treasury reached and passed the billion mark last week. During the month of February the incorporations of new companies in the Eastern States was greater than during any month since last June. The aggregate of companies capitalized at more than a million dollars amounted to $113,840,000, as compared with $72,150,000 for January. The market closed strong and dull on Monday, with copper shares the feature. Closing quotations for the week ending Feb. 29 are given in the above table.

NEW YORK.

	Feb. 21	Feb. 28	Shares sold		Feb. 21	Feb. 28	Shares sold
All-Ch.	5¾	5¾	———	Int.-Met., com...	6¾	7	4,120
All-Ch. pfd.....	17	17*	400	Int-Met., pfd...	17¾	20	1,625
Amal. Cop.....	47⅞	51⅞	175,540	Mackay Cos....	53	55	500
Am. D. T.....	39	—	———	Macay Cos. pfd.	60	59⅞	900
Am. Loc.....	32¾	32*	3,250	Met. St. Ry....	15	15*	200
Am. Loc. pfd..	89½	90	350	N. Y. & N. J. Tel.	80	—	———
Am. Tel. & C'bl.	44	—	———	Steel, com.....	28¾	28⅞	121,545
Am. T. & T...	106	105½*	190	Steel, pfd.....	92¼	92¼	26,000
B. R. T.....	40½	40⅜	19,575	W. U. Tel.....	46¼	49	2,300
Gen. Elec.....	115	116*	608	West'h, com....	39	41	1,040
Hud. R. Tel...	—	—	———	West'h, pfd....	—	—	———

BOSTON.

	Feb. 21	Feb. 28	Shares sold		Feb. 21	Feb. 28	Shares sold
Am. Tel & Tel..	106	106⅞	— — —	Mass. E. R. pfd.	41	—	———
Cumb'lnd Tel..	—	—	———	Mexican Tel...	—	—	———
Edison El. Ill..	—	—	— — —	New Eng. Tel'p.	107½	—	———
Gen. Elec.....	—	117¼	— — —	W'st. Tel. & Tel.	6	—	———
Mass. Elec. Ry.	10½	—	———	W. T. & T. pfd.	50	—	———

PHILADELPHIA.

	Feb. 21	Feb. 28	Shares sold		Feb. 21	Feb. 28	Shares sold
Am. Rys.....	42	42	———	Phila. Elec.....	5⅝	5¾	———
Elec. Co. of Am.	8¾	8⅝	———	Phila. R. T....	15	14½	———
Elec. Stor. B'ty.	26	26	———	Phila. Traction..	87	86	———
E. S. B'ty pfd.	—	—	———				

CHICAGO.

	Feb. 21	Feb. 28	Shares sold		Feb. 21	Feb. 28	Shares sold
Chicago City Ry.	172½*	—	———	Met. Elec. com.	18*	—	———
Com.-Edison ...	85¼	—	———	National Carbon.	50	51⅛	———
Chicago Subw'y.	16	17	———	Nat. Carbon pfd.	102	—	———
Chicago Tel. Co.	110	107⅜	———				

*Last price quoted.

TWIN CITY RAPID TRANSIT STATEMENT.—The full report of the Twin City Rapid Transit Company for the year ending Dec. 31, 1907, has been issued. Gross income for the fiscal year is given as $6,055,742, against $5,644,988 for 1906. Expenses were $2,980,435, against $2,675,379 for 1906. In consequence of court decisions against the company, and claims outstanding at the close of 1906, proving more than was anticipated, the reserves for injuries and damages were found to be inadequate, and an adjustment of $50,000, the estimated amount of deficiency, was accordingly made in the accounts of that year, thus reducing the surplus by a corresponding amount. Deducting the interest and taxes from the net gives a surplus for 1907 of $1,852,137, against $1,832,000 for 1906. After deducting 7 per cent on the preferred stock, the balance for common dividends of $1,215,000 equals 8.1 per cent on $20,100,000 outstanding common stock. The surplus is given as $131,137, against $237,682 for the previous year.

INTERBOROUGH BOND ISSUE.—Public Service Commission, it is stated on good authority, will shortly receive an application from the Interborough Rapid Transit Company, for permission to issue bonds for $50,000,000 to provide for the company's notes and other requirements. The amount of the first installment of these bonds will be $20,000,000 and the banking firm of Lee, Higginson & Company will put out the issue when market conditions warrant, or else use them as security for an issue of notes. The mortgage will cover the company's power-houses, rolling stock, the Steinway tunnel and the Long Island properties controlled by the Interborough. At the offices of Lee, Higginson & Company and August Belmont & Company no information either affirmatively or negatively could be obtained regarding the proposed issue.

N. Y. & N. J. TELEPHONE.—At the annual meeting of the New York & New Jersey Telephone Company, H. F. Stevens was elected a director to fill the vacancy caused by the resignation of H. S. Snow. The other directors were re-elected. The statement of the New York & New Jersey Telephone Company for the year ending Dec. 31, 1907, gives the gross income as $8,807,093, against $7,447,147 for 1906, and expenditures of $6,578,143, against $5,659,654 for 1906, leaving a balance of $2,138,741, which is equivalent to 8.42 per cent of the outstanding capital stock. Dividends of $1,687,311 were declared. The surplus is given as $451,430, which, added to the previous surplus given, the total surplus amounts to $4,877,325.

GEORGIA RAILWAY & ELECTRIC COMPANY.—The report of the Georgia Railway & Electric Company for the year ending Dec. 31, 1907, shows gross receipts of $3,309,341, an increase of $414,417 over 1906. Expenses for the year were $1,663,282, an increase of $235,431 over 1906. After deducting charges, there remained a surplus of $851,384, which represents a gain of $29,984 over the previous year. Deducting the preferred dividend of $120,000, and the common dividend of $428,448, an increase of $37,499 over 1906, leaves a balance surplus of $312,936, against $320,487 for 1906.

PENNSYLVANIA ELECTRIC VEHICLE.—An order of the Vice-Chancellor of New Jersey, making available at once for distribution in liquidation to stockholders of the Pennsylvania Electric Vehicle Company the sum of $40,000 cash, has been appealed to the Court of Errors and Appeals. There are 40,000 shares of preferred stock of a full par value of $10. At the beginning of the liquidation proceedings, the appraisement of the entire assets of the company was $4 per share of preferred stock.

DIVIDENDS.—The directors of the General Electric Company have declared the regular quarterly dividend, which will be 2 per cent, payable on April 15. The directors of the Lambertville Heat, Light & Power Company, of Lambertville, N. J., have declared the regular dividend of 1 per cent on its stock, payable March. 10. The American Smelting & Refining Company has declared a quarterly dividend of 1 per cent on its common stock, payable April 15, and the regular dividend of 1¾ per cent on its preferred stock, payable April 1.

KANSAS CITY RAILWAY & LIGHT.—For the month of January, the Kansas City Railway & Light Company reports a gross business of $496,321, as compared with $479,021, for the corresponding month of 1907. The net is given as $237,490, against $241, 004 for 1907. The surplus, after deducting charges, was $86,213, against $93,485 for the same month of the previous year.

CINCINNATI LIGHTING.—In a circular letter to the stockholders of the Union Gas & Electric Company, of Cincinnati, President Kenan states that the earnings of the company for the first sixteen months since taking over the local properties on a lease, after paying all charges provided for in the lease, were $481,697.10. The interest at 6 per cent on the $5,000,000 preferred stock outstanding for sixteen months was $400,000, leaving a surplus of $81,687.10. In all $1,500,000 has been spent in betterments, including the purchase of the plants and franchises of the Ohio Fuel Supply Company in Hamilton County, the enlargement and improvement of the central station plant, purchase of a site for a new station where all the generating machinery may be consolidated, extension of the gas and electric distribution system, and the completion of the high-pressure natural gas system. The price of labor, the letter states, has increased 25 per cent, while the efficiency has decreased, the hours being reduced from twelve to eight per day. Materials have advanced, but the company has been unable to make any increase in the price of its service. Severe losses were sustained by two floods during the year.

BROOKLYN LIGHTING FIGURES.—The stockholders of the Kings County Electric Light & Power Company held their annual meeting last week and the first report ever made public by the corporation was given out. According to the report the earnings of the company showed an increase in gross of nearly 20 per cent. The net showed an even larger increase on account of increased dividends and increased depreciation charges. The profit and loss surplus of the company made only a slight gain for the year. The operation of both the Kings County Electric Company and the Edison Electric Company is included in the report, as the entire capital stock of the latter is owned by the former. The gross income for the year ending Dec. 31, 1907, of the company was $3,471,740, against $2,897,272 in 1906. The operating expenses were $1,786,395 for 1907, against $1,511,686 for 1906. Dividends paid were $764,000, which is $172,000 more than was paid out last year. The total profit and loss balance was $1,181,213, against $1,159,359 for 1906.

CAMDEN-TRENTON RECEIVER.—Counsel for the Camden & Trenton Railway Company states that the recent application for a receivership has in view only a temporary receiver in order to put the line on a paying basis and make a profitable business proposition. The receipts had been running behind the expenditures for some time, but efforts for a refinancing of the company were in progress at the time the receivership petition was filed by former President Massey, of Philadelphia. It was believed that when the New Jersey Short Line was completed to Elizabeth, making a through line over the Camden & Trenton and the Trenton & New Brunswick roads from Philadelphia to New York, the Camden & Trenton line would undoubtedly be a paying one, but the financial stringency had tied up the work on the short line and had also hit the Camden & Trenton line.

NATIONAL CARBON REPORT.—The net earnings of the National Carbon Company for the year ending Jan. 31, 1908, were $924,801. After charging off preferred dividends, $315,000, the surplus, $609,801, is equal to 11.07 per cent on the common stock; and after deducting depreciation, $355,050, the surplus for common stock is 4.62 per cent. Following are the respective net earnings for the five years preceding Jan. 31, 1907: $951,801, $890,763, $846,307, $736,441, $594,372. The present valuation of plant is $8,647,882, and the total assets Jan. 6, 1908, $10,608,540. The preferred stock is $4,500,000 and the common stock $5,500,000.

MARCONI COMPANY REPORT.—The annual report of the Marconi Wireless Telegraph Company of America, which will be issued during the third week in March following the annual meeting, will, it is stated, show a gross monthly business of about $5,000 for 1907 over a monthly business of $1,100 for 1905. The Marconi Company was incorporated in 1899 with a capital stock of $6,650,000, par value $100, of which $6,190,000 was issued. The experimental transatlantic station at Glace Bay, Nova Scotia, was thrown open Feb. 1 for service limited to Montreal. The station has an operating capacity of about 10,000 words a day.

NIAGARA ELECTRIC DEVELOPMENT COMPANY.—On Feb. 26, at a meeting in Toronto of the stockholders of the Electric Development Company, at which $4,800,000 of the $6,000,000 common stock was voted, the control of the company passed without a dissenting voice to Mr. Wm. MacKenzie and his associates in the Toronto Railway Company. The meeting was presided over by Sir Henry Pellatt, who stated that the company had been so harassed by the Government, the Hydro-Electric Power Commission and the municipalities, that it had been found impossible to raise necessary funds by the sale of bonds.

HUDSON RIVER ELECTRIC POWER.—The gross earnings for the month of December, 1907, of the Hudson River Electric Power Company, were $124,202, an increase of $31,954 over the gross earnings of 1906 for the same month. The operating expenses were $62,132, an increase of $12,354 over December of the previous year, leaving net, for the month of December, $62,070, an increase of $19,600 over the same month in 1906. For the three months from Oct. 1 to Dec. 31 the increase in net was $188,647 against $102,327 for 1906, which is equivalent to 84 3/10 per cent.

UNION SWITCH & SIGNAL REPORT.—In the annual report for the year ending Dec. 31, 1907, of the Union Switch & Signal Company, the gross income was given as $5,023,598 against $5,065,675 for 1906, and the expenditures $3,998,756 against $4,010,343 for 1906. The net profits were $1,024,842, equal to 45.6 per cent on both classes of stock, against net profits of $1,053,332 for 1906. The total assets were $5,806,174 and the total liabilities $3,050,288; profit and loss surplus, $2,831,418. The annual meeting will be held on March 10.

J. G. BRILL COMPANY STATEMENT.—For the twelve months ending Dec. 31, 1907, together with the nine months output of the Wason Manufacturing Company, which was acquired by the J. G. Brill Company on April 1, 1907, the gross earnings amounted to $9,211,825 and the operating expenses $7,542,185. The report gives the net earnings as $1,368,949, with dividends of $375,574 and a credit surplus account of $993,375, which, added to the previous surplus account of $709,730, gives a total surplus on Dec. 31, 1907, of $1,703,105.

GENERAL ELECTRIC EARNINGS.—According to the *Wall Street Journal* the gross shipments of the General Electric Company for the fiscal year will approximate $70,000,000, an increase of about $10,000,000 over the preceding fiscal year, ended Jan. 31. At present the company is operating about 50 per cent of its normal capacity. The directors of the company will soon take action on the quarterly dividend and it is asserted that the regular dividend at the rate of 2 per cent quarterly will be declared.

KINGS COUNTY DIRECTORS RE-ELECTED.—At the annual meeting of the Kings County Electric Light & Power Company held last week the following directors were re-elected: Frank Bailey, William Berri, A. N. Brady, N. F. Brady, H. C. Du Val, Walton Ferguson, W. W. Freeman, Bernard Gallagher, Hugh J. Grant, Seth L. Keeney, Thomas E. Murray, W. F. Sheehan and A. M. Young. Later the above were re-elected as directors of the Edison Company.

AMERICAN GAS & ELECTRIC BONDS.—The $6,282,000 of the American Gas & Electric bonds now in the treasury of the Electric Company of America are to be offered in exchange for stock of the Electric Company of America in denominations of $1,000. Convertible script will be issued for fractional lots of the stock.

PHILADELPHIA ELECTRIC COMPANY.—In reply to a request from H. J. Horan, the Philadelphia Electric Company directors have instructed that L. E. Brown & Company, accountants, be asked to examine the company's accounts and prepare a detailed statement of the expenditures represented by capital account.

CHICAGO TELEPHONE.—The Chicago Telephone new stock issue, offered to stockholders as of record Feb. 19 at par, one share for four, making the rights worth 3¾, is to be paid for as follows: March 16, 20 per cent; May 15, 20 per cent; July 15, 40 per cent; Oct. 2, 20 per cent.

WILKES-BARRE GAS & ELECTRIC STATEMENT.—For the year ending Dec. 31, 1907, the Wilkes-Barre Gas & Electric Company reports gross earnings for the year of $361,349, an increase of $44,666, and net earnings, $173,320, an increase of $29,515.

LONG ISLAND CONSOLIDATED ELECTRIC COMPANIES.—The directors of the Long Island Consolidated Electric Companies were re-elected at the annual meeting held a few days ago.

GENERAL NEWS

Late items are printed unclassified at end of department

Construction News.

BRIDGEPORT, ALA.—A 10-year franchise has been granted C. A. Sutliff, of South Pittsburg, Tenn., for operating an electric light and power system in Bridgeport; also the construction of a street railway system. It is planned to construct an interurban system between Bridgeport, Ala.; Copenhagen, Richard's City, Jasper and South Pittsburg, Tenn. The company will be in the market for equipment.

CORNING, CAL.—Frank Houghton, George H. Flournoy and others have filed with the county clerk at Red Bluff notices of appropriation of 13,000 inches of water, together with all the flood waters of both Elder and McCarthy Creeks, in the western part of Tehama County. It is proposed to use the water for generating electricity, irrigation of land, domestic use, etc. Stephen E. Kieffer, of Berkeley, is engineer.

DEADWOOD, CAL.—The owners of the Lappin mine are contemplating installing electrical equipment to operate the mine.

DIXON, CAL.—Plans are being made to sink a large well in the Dudley tract, lately subdivided. The water will be pumped by electricity.

NEEDLES, CAL.—Arrangements have been completed to erect an electric lighting system in Needles. A contract has been made with the Victor Gold Mining Company to furnish electrical energy for operating the system. Work has commenced on the erection of the transmission lines in the city.

OAKLAND, CAL.—The City Council has appointed a committee to confer with a like committee of the Board of Trustees of Berkeley to consider the erection of a municipal electric light plant to supply service for both cities.

OROVILLE, CAL.—The Great Western Power Company has purchased the franchise sold by the Board of Supervisors of Butte County, Feb. 15, for a pole line for the transmission of electricity in the county for $481.75. The line will be built on a private right of way.

OROVILLE, CAL.—The Northern California Mining Company, of which H. H. Yard is the chief owner, is perfecting plans for two power plants which will utilize the water of Fall River, a branch of the middle fork of the Feather River, and will be located in the Mooretown district, about 40 miles above Oroville. At one place a fall of 1000 ft. can be secured, with a minimum flow of 2000 miners' inches of water.

PASADENA, CAL.—Heman Dyer, city clerk, writes that the citizens on Feb. 20 voted to issue $20,000 in bonds for the construction of pole lines for the distribution of electricity.

RED BLUFF, CAL.—Leon Bly has filed a notice of the appropriation of 6000 inches of water to be taken from South Battle Creek. The water is to be diverted by means of a 48-in. inverted siphon and carried by flume and through a tunnel to the place of use. The water power is to be used to generate electricity.

REDLANDS, CAL.—C. S. Chesnut, president of the Home Gas & Electric Company, of Redlands, is interested in a company to be formed here to be known as the Consolidated Gas & Electric Company, with a capital stock of $1,000,000 to furnish electricity to Redlands, San Bernardino, Colton, Highgrove, Crestmore; also to supply gas to the above cities and to Riverside. The independent companies of Redlands, Colton, San Bernardino and Riverside will be taken into the new company. The electric light plant of the Home Gas & Electric Company will be enlarged and made the principal plant of the company. The main offices of the company will be located at Redlands.

RICHMOND, CAL.—Work has commenced on the construction of the power house of the Santa Fé system, which is located near the freight sheds of the company. Electricity is to replace steam power for operating the mechanical departments of the shops. The cost of the building is estimated at $14,000.

VISALIA, CAL.—Announcement has been made by the Balfour-Guthrie Company that plans are being prepared for many improvements in and about Strathmore, including the installation of an electric light system.

DENVER, COL.—A company has been incorporated to construct an electric railway from Debeque to Fruita, a distance of 40 miles. It is proposed to build a power plant on the Grand River, near Debeque, to supply electrical energy to operate the road, work on which has already commenced. An irrigation system is also being laid out to reclaim 20,000 acres. The cost of the power plant is estimated at $600,000 and about 6500 horse-power will be developed. The officers are Horace K. Devereaux, of Colorado Springs, president; J. Arthur Connell, vice-president, and E. A. Sunderlin, secretary and treasurer.

SAYBROOK, CONN.—The Shore Line Electric Railroad Company has awarded a contract to the Sperry & Sellers Company for the construction of its proposed power station in Saybrook. Plans are also being drawn for a car barn.

SOUTH NORWALK, CONN.—The city of South Norwalk has voted to furnish the East Norwalk Fire District with electrical energy at the rate of 5 cents per kw-hour. It is proposed to furnish electricity at 220 volts, direct current, not to exceed 50 hp for the first three years, to a rotary converter to be located in South Norwalk, with a minimum rate of $50 per month.

WILMINGTON, DEL.—The People's Railway Company has made application to the Street and Sewer Department for a franchise to build an electric railway on certain streets here.

WASHINGTON, D. C.—Bids will be received until March 10, at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., to furnish at the navy yards and naval stations the following supplies: Mare Island, Cal., Schedule 790, 6000 ft. interior communication cable, 4000 ft. bell wire, about 77,500 ft. single lighting wire, 155,000 ft. twin lighting wire, 40,000 ft. insulated wire, wiring appliances, interior fittings and conduit fixtures. Applications for proposals should designate the schedule number. E. B. Rogers is paymaster-general, U. S. N.

ATLANTA, GA.—The Atlanta & Carolina Railroad Company has awarded the contract for the construction of its railway within the city limits to Cook & Lowry, contractors. James W. English is president of the railway company.

AUGUSTA, GA.—The United States Senate has passed a bill authorizing the Twin City Power Company to construct two dams across the Savannah River above Augusta.

DUBLIN, GA.—At an election held Feb. 25 the citizens voted to issue $60,000 in bonds, the proceeds to be used for improvements to the municipal electric lighting plant and water works system.

MACON, GA.—The Macon Railway & Light Company is planning to rebuild 12 miles of track, also a two-mile addition.

MACON, GA.—The Board of Aldermen has granted a franchise to the Citizens' Electric Company. The franchise is for a term of 50 years, under the terms of which the company must have its plant under construction within ten months, and the minimum cost of the plant is to be $100,000. The company is to furnish electrical energy for lamps at a rate of not more than 10 cents per kw-hour, and to allow a discount of 10 per cent for all bills paid on or before the 10th of the month. The maximum price for electricity for motors is not to exceed 8 cents, with the same discount. The company is to furnish arc lamps of 2000 cp for street lighting for $70 each per year. After the expiration of seven years after the completion of the plant the company is to pay to the city 1 per cent of the gross receipts of the earnings of the company from all sources for the next seven years, and after the expiration of that period a per cent of the gross receipts is to be paid to the city to be continued during the life of the franchise. E. W. Gould, Howard M. Smith and others are interested in the company.

MONTEZUMA, GA.—Bids will be received by the Town Council until April 1 for the construction of a canal, water-power system and complete pumping station. Dr. C. H. Richardson is Mayor.

LEWISTON, IDAHO.—Announcement has been made that Jay P. Graves, president of the Spokane Inland Electric Railway Company, is considering the proposition of taking over the rights of way and franchises acquired by the Lewiston & Southeastern Railroad Company, and supplying the funds for the construction of the railway between Lewiston and Grangeville. The railway will be 90 miles in length.

CARLISLE, ILL.—The citizens on Feb. 26 voted to make extensions and improvements to the electric light plant and water works system, involving an expenditure of about $30,000.

CHICAGO, ILL.—A permit has been issued for the erection of the power house for the Presbyterian Hospital at 301 Hermitage Street to cost $70,000.

CHICAGO, ILL.—The City Council has passed an ordinance authorizing the Chicago Railways Company to construct an extension of its system in Harrison Street, from Kedzie Avenue to Fortieth Avenue.

DUQUOIN, ILL.—The City Council has granted a 25-year franchise to J. H. Gregory and Frank J. Schieper to erect and operate a telephone system in the city. It is said that the Kinloch Telephone Company, of St. Louis, Mo., is interested in the project and will superintend the construction of the system.

PEORIA, ILL.—Plans are being prepared by Theodore Kipp, Jr., for installing an electric light system at the county farm.

SILVIS, ILL.—The towns of Silvis and East Moline are considering the question of granting a lighting franchise to W. H. Downing, of Silvis.

ANDERSON, IND.—The Delaware & Madison Counties Telephone Company has decided to erect a new exchange building in this city. The cost of the building exclusive of equipment is estimated at $25,000. George W. Beers, of Ft. Wayne, is president of the company.

BLOOMINGTON, IND.—The Citizens' Telephone Company, recently organized, has arranged to proceed with the erection and equipment of a new central energy telephone system in this city. The officers of the company are: James A. Karsell, president; Dr. A. L. Foley, secretary, and W. H. Adams, treasurer.

CICERO, IND.—After having been in darkness for some time, on account of the lighting plant having been destroyed by fire, the city is

soon to be lighted again by electricity. The Noblesville Light, Heat & Power Company is erecting a transmission line from Noblesville to Cicero, a distance of 8 miles. The town is already wired, and the franchise calls for incandescent lamps.

CLARKSVILLE, IND.—The Clarksville Telephone Company wishes to correspond with a construction company, with view of letting contract for the construction of a new plant.

DECATUR, IND.—The Fort Wayne & Springfield Railroad Company has filed a notice with the Secretary of State of an increase in the capital stock of the company from $500,000 to $1,000,000. W. H. Fledderjohan is president of the company.

ELWOOD, IND.—It is reported that the Delaware & Madison Counties Telephone Company has purchased the Central Bell Company's plant in this place, including exchange, poles, wires, etc.

EVANSVILLE, IND.—The Evansville & Eastern Traction Company is planning to construct a new railway from Evansville to Newburg, a distance of 10 miles.

EVANSVILLE, IND.—The American Long-Distance Telephone Company has secured a site on Fulton Street, on which it will erect an exchange building. Herman S. Romberg is general manager.

EVANSVILLE, IND.—The American Telephone Company has filed a $2,000 bond required as a guarantee of fulfilment of the conditions of a franchise permitting the building and equipment of a trunk line station in this city. Engineers are now at work drafting plans for the structure and lines that will have to be rebuilt.

GOSHEN, IND.—Announcement has been made that the Goshen-Battle Creek Railroad is planning to equip its railroad to be operated by electricity.

HANOVER, IND.—The Hanover College Trustees have ordered plans and specifications for the installation of a general water and lighting system in the college buildings and grounds.

NEW LISBON, IND.—The capital stock of the New Lisbon Telephone Company has been increased from $7,500 to $15,000. John A. Miller is secretary.

NEW MARION, IND.—The New Marion & Holton Telephone Company, recently incorporated, is in the market for material and labor for the construction for a new telephone system. J. N. Hess is president of the company.

OAKLAND CITY, IND.—Suit has been filed against the Cumberland Telephone Company for a permanent injunction restraining the company from further operation in the town. The company was given 30 days to vacate the streets, but the time expired, the company paying no heed to the notice. The company claims to have a perpetual franchise, under which it is operating.

PAOLI, IND.—The Town Board has decided to take over the electric plant of the Paoli Milling Company. New machinery will be installed and the output of the plant increased to supply electricity for commercial lighting as well as to light the streets. The price paid for the plant was $1,700.

TERRE HAUTE, IND.—T. F. Grover, general manager of the local power house of the Terre Haute, Indianapolis & Eastern Traction Company, states that plans are being made to enlarge the power house and install a new 500-kw generator.

IOWA FALLS, IA.—The Iowa & Northwestern Railway Company has secured franchises for an electric light plant and water works system in the town of Quasqueton. It is said that the electric railway will be built early in the spring.

QUASQUETON, IA.—Frank Vierth, city clerk, writes that Stephen B. Howard, of Waterloo, has been granted a franchise to erect an electric light plant in the town.

FRANKFORT, KAN.—Bids will be received by the city clerk until March 17 for furnishing material and labor for constructing a system of water works, separate bids for which will be received as follows: For furnishing all material and labor, except cast iron pipe, hydrants and valves, tower and tank, and pumping machinery, and constructing a complete water works system. Also for furnishing one 300-gallon per minute triplex power pump; for furnishing and erecting one 30-hp gasoline engine; for furnishing and erecting 30-hp, 720 r.p.m., 60-cycle, three-phase motor and for furnishing material and erecting steel tower and tank of 70,000 gal. capacity. Plans and specifications are on file at the office of the city clerk, Frankfort, and at the office of Burns & McDonnell, Scarritt Building, Kansas City, Mo. J. M. Shumate is city clerk.

HERRINGTON, KAN.—We are informed that the contract for the construction of the municipal electric light plant and water works system has been awarded to the Squire Electric Company, of Kansas City, Mo., for $32,750. C. H. Randall is chairman of the Water and Light Commission.

MARION, KAN.—The citizens have voted to issue $35,000 in bonds, of which $15,000 will be used to purchase the old water works system, and the remainder for repairing the plant and for erecting an electric light plant.

OPOLIS, KAN.—We are informed that the town of Opolis has decided to construct an electric light plant, the cost of which is estimated at about $3,000. James Denton is engineer.

CARROLLTON, KY.—The city is arranging to issue $20,000 in bonds, the proceeds of which to be used for extensions and improvements to the municipal electric light and water plants.

SHREVEPORT, LA.—The City Council has granted a franchise to John Lorenz to operate a street car system in this city in conjunction with the present traction system.

BIDDEFORD, ME.—Preparations are being made by the Limerick Mills to operate the worsted yarn plant by electricity.

ELLSWORTH, ME.—The Bar Harbor & Union River Power Company is preparing plans for extending its transmission line to Bar Harbor, and will soon apply to the city government for a franchise. The line will have a potential of 30,000 volts. J. A. Leonard is chief engineer.

CONOWINGO, MD.—A bill has been introduced in the State Legislature amending the charter and enlarging the powers of the Susquehanna Power Company. The company proposes to build a large dam below Conowingo for the purpose of developing power to generate electricity and erecting transmission lines to Baltimore, Wilmington and Philadelphia for the transmission of electricity. The company also proposes to build 29 miles of canals from Port Deposit, Md., to Columbia, Pa.

FEDERALSBURG, MD.—The House of Representatives has passed the bill authorizing the incorporation of the Idlewood Electric Light & Power Company.

BARRE, MASS.—Preparations are being made by the Francis Willey Company for the construction of a new dam at the former site of the American Powder Company's plant in Barre. The water power will be used to generate electricity for lamps and motors for the South Barre mill.

LYNN, MASS.—The Lynn Gas & Electric Company has received authority from the State Commission of Gas and Electricity to issue 1950 additional shares to be offered to the stockholders at $235 per share. The proceeds to be used toward the cancellation of an equal amount of obligations outstanding, and for payment of the cost of additions to the plant.

MALDEN, MASS.—The State Commission of Gas and Electricity has approved an issue of 1000 additional shares of the Malden Electric Company to be offered to the stockholders at $145 per share, the proceeds to be used to cancel an equal amount of promissory notes outstanding Nov. 30, 1907.

NEEDHAM, MASS.—The Edison Electric Illuminating Company, of Boston, has purchased the municipal electric lighting system for $11,000. In conjunction with the sale of the plant, the town enters into a contract with the company whereby it is to furnish electricity for the street lamps for a period of 20 years for $12 per lamp per year, the contract to take effect Sept. 1. 1908.

NORTH ATTLEBORO, MASS.—A petition has been filed with the Board of Selectmen asking for an appropriation of $200 to look into the finances of the electric light department.

CHARLOTTE, MICH.—The capital stock of the Grand Ledge Telephone Company has been increased from $25,000 to $50,000.

GREENVILLE, MICH.—The Council has granted a 10-year franchise to R. J. Tower to construct and operate an electric light plant. It is proposed to furnish a 24-hour service.

MANISTIQUE, MICH.—The City Council on Feb. 24 granted a 30-year franchise to the Manistique Light & Power Company, and has awarded it a franchise for lighting the streets of the city and for furnishing electricity for pumping the city water supply. This ends a contest that has figured in the town elections for the past four years.

BUFFALO, MINN.—The citizens are considering the question of installing an electric light plant and water works system, and an election may be held to vote on the proposition.

MINNEAPOLIS, MINN.—Bids will be received until March 16 by the Board of County Commissioners for the construction of a lighting plant for the county farm. Bids will be received on both electric and acetylene lighting. Hugh R. Scott is county auditor.

CHARLESTON, MISS.—W. C. Myers is reported to be interested in establishing an electric light plant in this place.

OXFORD, MISS.—R. S. Adams, Mayor, writes that the contract for machinery for the municipal electric light plant will be let about April 1. The contract for the construction of the building has already been awarded. J. R. Shinault is engineer.

LINNEUS, MO.—The citizens have voted to issue bonds to rebuild the electric light plant, which was recently destroyed by fire.

ST. LOUIS, MO.—Attorney E. C. Slevin, representing electric light promoters, has made application to the Board of Public Improvements to include a franchise in the contract for city lighting, an ordinance authorizing the letting of which will be introduced in April. He stated that certain promoters desired to bid on the contract who do not now have a franchise to lay conduits in the streets.

FAIRBURY, NEB.—The Fairbury Independent Telephone Company has awarded a contract for the construction of a new building on Fourth Street. In addition to the new building, the company plans to expend about $20,000 for new equipment and extension of lines. C. W. Bartlett is manager of the company.

WYMORE, NEB.—The citizens are considering the question of installing an electric light plant at the city pumping station to furnish electricity for lighting the city.

GOLDFIELD, NEV.—The Nevada-California Power Company has placed an order with the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., for two 1500-kw generators and accessories required for the equipment of its power house to be erected in Goldfield.

The plant will furnish electrical energy for the mines in the Goldfield district and in Tonopah.

MANHATTAN, NEV.—An electric power plant is being installed at the property of the Nevada Milling & Ore Purchasing Company.

RENO, NEV.—The City Council has granted a franchise to S. H. Wheeler and Charles Burke, of Reno, to construct an electric railway in Reno, from the Southern Pacific depot into the southeastern portion of the city.

WARREN, N. H.—The Warren Water & Light Company has purchased the boiler formerly used in the George Williams Mill and will install it in its electric plant.

ATLANTIC CITY, N. J.—J. W. Hackney, city engineer, writes that the contract for furnishing corner and intermediate lighting standards, bids for which were opened Feb. 24, has been awarded to the Bethlehem Foundry & Machine Company, of South Bethlehem, Pa., for $34,177.

CAMDEN, N. J.—The lighting committee of the City Council has decided to recommend the acceptance of the proposition of the Public Service Corporation to furnish electricity for lighting the city for a period of six and one-half years for $80 per arc lamp per year. Under the present contract, which expires June 30, 1909, the city pays at the rate of $109.50 per lamp per year. The Public Service Corporation proposes to date the new contract as of Jan. 1, 1908. This in itself will save the city $27,000.

JERSEY CITY, N. J.—Jabez Bruns & Sons have appointed Putnam A. Bates, 42 Broadway, New York, N. Y., to have charge of the equipment of their new factory building, in connection with which a power plant will be installed to furnish light, heat and power for the factory.

JERSEY CITY, N. J.—The Street and Water Board has authorized its president and Mayor Wittpenn to enter into a contract with the Public Service Corporation of New Jersey for lighting the streets of the city by electricity for a term of five years, beginning from Feb. 1. Under the terms of the contract the company is to furnish energy for arc lamps at the rate of $75 per lamp per year up to 2500, when the price per lamp will be reduced to $70. The city at present has between 1500 and 1600 arc lamps, for which it has been paying $97.50 per lamp per year. The new rate effects a saving of $22.50 per lamp per year.

MORRISTOWN, N. J.—The Commissioners of Morris Township on Feb. 15 granted a franchise to the Morris & Somerset Electric Company to erect transmission lines and lay conduits for street lighting on the streets and avenues of the township with certain restrictions.

PRINCETON, N. J.—The Borough Council is contemplating establishing a municipal electric light plant. A committee of three will be appointed at the next meeting of the Council to investigate the matter and report to the Council.

RAHWAY, N. J.—The Public Service Corporation has submitted a proposition to the Common Council offering to furnish electricity for lighting the town as follows: For 25 arc lamps of 1200 cp at $100 per lamp per year; 300 or more 24-cp incandescent lamps at $16 per lamp per year.

TRENTON, N. J.—The Board of Health is reported to be considering the question of installing an electric light and heating plant in the municipal hospital.

WHARTON, N. J.—The streets of the borough are now lighted by electric lamps, electricity for which is supplied by the Dover Electric Light Company, of Dover. Thirty-five lamps have been installed on the streets and 21 more will soon be added.

SILVER CITY, N. M.—The Forest Service has issued a permit to the Forest Power Company of this city to construct and maintain an electric power house and transmission line in the Gila national forest.

ALBANY, N. Y.—Assemblyman De Groot has introduced a bill in the State Legislature providing for electricity to be furnished in the boroughs of Brooklyn and Queens at the rate of 10 cents per kw-hour. The present rate is 12 cents per kw-hour.

BABYLON, L. I., N. Y.—The Village Board has granted the Babylon Electric Light Company a 50-year franchise to furnish electricity for lamps and motors; also a franchise to furnish gas for lighting and heating purposes.

CHATHAM, N. Y.—The Chatham Electric Light, Heat & Power Company is making arrangements to establish a power service for Chatham and vicinity, and will install a 200-hp power boiler in the near future. The company also plans to extend its transmission lines from Ghent to the village of Philmont, a distance of six miles, to furnish electricty for lamps.

CLYDE, N. Y.—Parties representing the Fort Wayne Electric Company, of Syracuse, are dismantling the defunct plants of the Clyde Gas & Electric Company, of this village. The machinery, boilers and other equipment are being removed and shipped to Syracuse. The electric plant of the Clyde Gas & Electric Company was erected in 1890, but for the past six years has not been in use.

EARLVILLE, N. Y.—The plant and holdings of the Earlville Telephone Company have been purchased by Charles Chandler, of Brookfield, and Jerry D. Holey, of Earlville. The consideration is understood to be about $20,000.

HAVERSTRAW, N. Y.—The Board of Trustees has granted the West Shore Traction Company a franchise for a right of way through the town.

HUDSON, N. Y.—The directors of the Albany & Hudson Railroad Company have decided to begin work at once on the proposed improvements to the power station at Stuyvesant Falls. A new boiler will be installed and other changes made at the station to increase the output of the plant to meet the increased demand for electrical energy, due to the heavy travel over the third-rail system during the summer.

SPENCERPORT, N. Y.—The Ogden Telephone Company, recently organized, is perfecting plans for the construction of a telephone system, which will include both the Spencerport and Adams Basin exchanges. A meeting of the directors will soon be held to decide whether the company shall purchase the Bell plant or build its own system. H. D. Burritt, of Ogden, is vice-president of the company.

WATERTOWN, N. Y.—The Watertown Chamber of Commerce has started a movement to purchase the telephone system of the Citizens' Telephone Company. It is proposed to install a new switchboard and other equipment. It is stated that the plant and holdings of the company can be purchased for $15,000. J. B. Wise is interested in the project.

ARLINGTON, OHIO.—The municipal electric light plant was started Feb. 11. The equipment of the plant includes a 65-kw alternating-current Warren generator and an Atlas engine and boiler.

COLUMBUS, OHIO.—The pole line of the municipal electric lighting system is being rearranged under the supervision of D. J. Fisher, director of the Service Board. It is expected that under the new system the city will save about $4,000. The street lighting system will soon be increased by 300 additional lamps, making 2400 in all. Frank Tennant is city electrician.

COLUMBUS BARRACKS, OHIO.—Bids will be received until March 14 for furnishing and delivering electric light fixtures for three double sets of lieutenants' quarters and all necessary material for electric light wiring, electric bell system and speaking tubes for the above-mentioned buildings, including conduit, wire, switches, panel boards and cabinets, annunciators, tools, etc. A complete list of the material and fixtures required divided into separate items, together with instructions to bidders and blank forms for proposals can be obtained at this office on application. Bids will be received on all or part of the items required. Captain H. J. Hirsch is in charge of construction.

FORT TOWSON, OKLA.—C. P. Walker, manager of the Fort Towson Light & Power Company writes that the high-tension plant built by the company was put into operation Feb. 20.

MENTOR, OHIO.—The citizens are considering the question of the erection of an electric light plant.

KLAMATH FALLS, ORE.—The citizens are considering the question of constructing water works, electric light plant and sewerage system.

PENDLETON, ORE.—The City Council is considering the question of establishing a municipal electric light plant. The street lighting contract was renewed with the Northwestern Gas & Electric Company for two years only.

PORTLAND, ORE.—Extensive improvements are planned for this year by the Pacific Telephone & Telegraph Company to its local system, which will involve an expenditure of about $500,000. It is proposed to extend the underground conduit system throughout the entire fire district. The company has already installed more than 150 miles of underground duct. The company will soon install a local exchange in St. John.

SCIO, ORE.—It is reported that extensive repairs are needed to the municipal electric light plant, including a new penstock, flume and water wheel.

ALLENTOWN, PA.—The Blue Ridge Traction Company has closed its power station at Danielsville, and is now receiving electrical energy for operating its system from the Lehigh Valley Transit Company.

BOYERTOWN, PA.—A permit has been granted to Louis Wanner, Jr., to install a power plant and a heating system in the building of the Boyertown Burial Casket Company at 1211-1217 Arch Street, to cost $9,067.

BUTLER, PA.—The capital stock of the Harrisville Telephone Company has been increased from $5,000 to $15,000.

EASTON, PA.—At an election to be held April 2 the citizens will be asked to vote on the proposition to issue $30,000 in bonds for extensions and improvements to the municipal electric light plant. Martin M. Higgins is Mayor.

ELLWOOD CITY, PA.—A local company has been organized and application has been made for a charter to build an electric railway from Ellwood City through Burnstown, Wurtemburg and up the Slipperyrock Valley to Butler. The incorporators are J. T. Meckler, John M. Curry, J. N. Kirker and J. C. Keith, of Ellwood City.

JOHNSTOWN, PA.—Contracts will soon be let by the Cambria Steel Company for equipment to be used at the Rolling Mill Mine and the Millcreek power plant, the cost of which is estimated at $50,000. It will include two new batteries of boilers, a compound steam engine and a dynamo for the electric light plant, additional cutters, drills, etc., for the mining equipment of the plant. Powell Stackhouse is president.

McKEESPORT, PA.—Arrangements are being made by the Manor Valley Railway Company to commence work on the construction of its railway to Herminie and to West Newton. The rights-of-way are being secured for the northern division from Manor to Claridge.

NEWTOWN, PA.—The Borough Council has entered into a contract with the new electric light company to light the streets of the borough. The company is to furnish incandescent lamps of 32 cp for $27 per lamp per year.

NEWVILLE, PA.—The contract for the construction of the electric light system to light the streets of the city has been awarded to John Hosfield, of Shippensburg.

SUNBURY, PA.—The Borough Council has granted a franchise to the Sunbury & Selinsgrove Electric Street Railway Company to operate its railway on certain streets in the borough.

WEST CHESTER, PA.—The stockholders of the West Chester, Kennett & Wilmington Electric Railway Company, of West Chester, and the Oxford, West Grove & Avondale Street Railway Company have effected a merger of the properties of the two companies. The first company has 18 miles of track, and controls the Oxford, West Grove & Avondale line, which is under construction from Avondale to Oxford, a distance of 12½ miles. A portion of the road is already being operated.

ABERDEEN, S. D.—The Aberdeen Light & Power Company is said to have placed orders for the machinery for its new plant with the Minneapolis Steel & Machinery Company, and for electrical equipment with the Electric Machinery Company, both of Minneapolis, Minn. The company was recently organized with a capital stock of $200,000.

RAPID CITY, S. D.—G. B. Mansfield, secretary of the Dakota Power Company, writes that the proposed plant of the company will cost about $170,000. L. A. Richards, of Rapid City, is manager.

FAYETTEVILLE, TENN.—It is reported that the Fayetteville Electric Light & Power Company contemplates increasing the output of its power plant.

DALLAS, TEX.—W. F. Nicol, supervising architect of the Board of Education, writes that bids will soon be received for the electrical work on the new nigh school, now in course of erection, the cost of which is estimated at about $4,000.

FORT WORTH, TEX.—Sealed proposals will be received by the city of Fort Worth for 1200-cp 6.6 ampere alternating-current series arc lamps, complete with inner and outer globes for street lighting. Bids will be received on lots of 250, 500 and 750 lamps. J. J. Nunnally is city auditor.

HOUSTON, TEX.—The contract for the construction of the automatic telephone system for the Houston Home Telephone Company has been awarded to the Automatic Construction Company, of Houston, recently organized. The Automatic Electrical Company, of Chicago, Ill., will furnish the equipment for the system, and the Orangeburg Fibre Company has secured the contract for supplying the conduits. The contract for the cables has not yet been awarded. The cost of the work is estimated at about $800,000. F. G. Reed and John S. Slusher are the promoters of the company. McMeen & Miller, of Chicago, Ill., have prepared plans and will superintend the work.

MARBLE FALLS, TEX.—G. W. Vories, vice-president and general manager of the Granite Manufacturing Company, writes that the company has engaged the services of Dwight F. Horton, of Houston, as designing and constructing engineer to build a dam across the Colorado River at Marble Falls, for the purpose of power development and transmission of electricity, the work to be done by day labor, by the company. Electrical energy will be transmitted at 33,000 volts within a radius of 50 miles of the plant. It is proposed to install ten 1000-kw units.

NAVASOTA, TEX.—A franchise has been granted to R. A. Horlock Company to construct an electric light plant to furnish electricity for lighting the town. The equipment of the plant will consist of a 250-hp Corliss engine, a 120-kw, three-phase, 60-cycle, alternator and a 50-kw generator direct connected, switchboards, transformers, etc. R. W. Horlock is manager.

AMERICAN FORK, UTAH.—Surveys have been completed for the transmission line of the Utah County Light & Power Company from its plant at Grand Fork to Knightsville, a distance of 42 miles. The line will be operated at a potential of 44,000 volts.

MONTPELIER, VT.—Plans are being made to install a new lighting system in the Washington County Court House.

EDENBERG, VA.—H. A. Whissen & Brother have applied to the town officials for a franchise to install an electric light plant in the town.

RICHMOND, VA.—Edward W. Trafford, a consulting engineer of this city, has submitted to a joint meeting of the Council committees on water and electricity a proposition to prepare complete plans for a municipal electric light plant on the site of the old pump house, with surveys and maps of the river and water power of the city. The plans are to include a transmission line to the new pump house, the installation of electrical pumps at the pumping station and a complete system of poles and wires for street lighting covering the entire city.

PROSSER, WASH.—The Prosser Traction Company is planning to make a number of extensions to its system. The power plant will be located five miles below Prosser.

HUNTINGTON, W. VA.—At a meeting of the stockholders of the Camden Interstate Railway Company, the name of the company was changed to the Ohio Valley Traction Company, and it was decided to issue $400,000 in capital stock, which, it is said, will be used to acquire the system of the Kanawha Valley Traction Company. W. C. Sproul, of Chester, Pa., is president of both companies.

APPLETON, WIS.—C. H. Hartley and F. H. Josslyn, of Oshkosh, are negotiating with E. A. Edmonds, president of the Badger Portland Cement Company, to furnish electrical energy to operate the company's plant. Messrs. Hartley and Josslyn are members of a company which controls two water powers on the Peshtigo River, not far from Erland Junction, and, if the deal is consummated, it is proposed to erect a transmission line across Green Bay from a point midway between Peshtigo and Marinette to Little Sturgeon, a distance of 14 miles.

ASHLAND, WIS.—The City Council has decided to have plans prepared at once for the construction of a municipal electric light plant.

FOND DU LAC, WIS.—The Eastern Wisconsin Street Railway & Light Company is planning to rewire its entire system this spring.

GREEN BAY, WIS.—Bids will be received by Elmer Hall, county clerk, until March 16, for the construction of a power house for Brown County.

IOLA, WIS.—The Village Board has closed a contract with Frogner Brothers & Sons for street lighting for a term of five years. The company is to furnish 35 incandescent lamps of 32-cp each at the rate of $16.80 per lamp per year, making a total cost of $588 per year.

MILWAUKEE, WIS.—A building permit has been granted to the Continental Realty Company for the construction of a power plant on Commerce and Holton Streets at a cost of $65,000.

MILWAUKEE, WIS.—No bids were opened on Feb. 13 by the Board of Public Works for furnishing and erecting a gas producer plant at Walker and Davidson Streets, as a part of the municipal electric light plant, as it was decided to wait until the result of the election on the question of constructing the proposed municipal lighting plant.

OSHKOSH, WIS.—Two water power sites have been purchased on the Wolf River, near Royalton, by Leander Choate, Frank H. Josslyn, Emil H. Steiger and Casper Faust, all of Oshkosh. It is proposed to erect a power plant and develop between 2000 and 2500 hp. If possible, the electrical energy will be transmitted to Oshkosh to be used for lamps and motors. A delegation of business men from New London have petitioned the owners of the water power to furnish that city with electricity.

SULLIVAN, WIS.—The Sullivan Telephone Company has increased its capital stock from $10,000 to $15,000.

HAMILTON, ONT., CAN.—The City Council has appointed P. W. Sothman, chief engineer of the Hydro-Electric Commission, to prepare plans and specifications for the proposed municipal electric lighting plant.

MONTREAL, QUE., CAN.—The Park & Island Railway Company has decided to extend its line on the upper Lachine Road a distance of one mile.

NELSON, B. C., CAN.—Owing to the exorbitant figure quoted for additional energy by the West Kootenay Power Company, the city refused to consider the offer and decided to lose no time in installing an additional unit at the municipal power plant.

TORONTO, ONT., CAN.—William Mackenzie, president of the Canadian Northern Railroad, has purchased a controlling interest in the Electrical Development Company, and it is reported that the eastern lines of the Canadian Northern will be equipped to be operated by electricity to be furnished by the Electrical Development Company.

WELLANDPORT, ONT., CAN.—The Dunnville, Wellandport & Beamsville Electric Railway Company has applied to the Legislature for permission to extend its railway through the townships of Durham, South Cayuga, Rainham, Walpole and Woodhouse to Port Dover.

WINNIPEG, MAN., CAN.—The Law Amendments Committee of the Manitoba Legislature has given a decision against allowing the city of Winnipeg to deal in electricity for domestic purposes. F. E. Cambridge, city electrician.

New Industrial Companies.

THE GRAVITY ELECTRICAL COMPANY, of Milwaukee, Wis., has been incorporated, with a capital stock of $30,000, by Frank J. Kipp, Louis Auer and Fred B. Peterson.

THE ENTERPRISE ELECTRIC WORKS, of San Francisco, Cal., have been incorporated, with a capital stock of $24,000, by Frank Jones, G. E. Roe, Bertha Roe and Mary E. Jones.

THE WORLD TELEPHONE MANUFACTURING COMPANY, of Seattle, Wash., has filed articles of incorporation, with a capital stock of $1,000,000, by Charles McGonigle and Gustave S. Staly.

THE REVERSIBLE GAS ENGINE COMPANY, of Portland, Me., has been incorporated, with a capital stock of $100,000. G. H. Sturgis is president and F. D. Marshall treasurer, both of Portland, Me.

THE ELECTRICAL REPAIR & CONSTRUCTION COMPANY, of Cleveland, Ohio, has been incorporated, with a capital stock of $10,000, by Edward Snyder and others. The company will deal in motors and other electrical apparatus and equipment.

THE UNITED STATES ART BENT GLASS COMPANY, of Hartford, Conn., has filed a certificate of incorporation, with a capital stock of $20,000. The company proposes to manufacture various articles of ornamental glass and electric lamp appliances.

THE HARRIMAN ENGINE COMPANY, of Boston, Mass., has been incorporated, with a capital stock of $100,000, for the purpose of manufacturing machinery. W. R. Harriman, of Malden, is president of the company and J. E. Harriman, of Brookline, is treasurer.

THE ACTOGRAPH COMPANY, of New York, N. Y., has filed articles of incorporation, with a capital stock of $30,000. The company proposs to manufacture and deal in moving picture machines. The incor-

porators are: A. V. Jones, H. M. Browne, of New York, and H. W. Mills, of Jersey City, N. J.

THE BLEYLE ELECTRIC COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $10,000, by E. Theodore I. Thygeson, of Brooklyn, N. Y.; Frank K. Hoffman, of New York, N. Y., and Timothy J. Murphy, of Newark, N. J. The company proposes to manufacture electric motors, dynamos, etc.

THE UTILITY FIXTURES COMPANY, of New York, N. Y., has filed articles of incorporation, with a capital stock of $20,000, for the purpose of manufacturing electric lamps, lighting devices, lamp fixtures, etc. The incorporators are: Thomas Donahue, John A. Potter and James O. Tyron, all of New York, N. Y.

Company Elections.

KING'S MILLS, ARK.—At the annual meeting of the Union Telephone Company the following-named officers were elected: E. W. Holt, president; J. T. Spurlock, vice-president; D. Rogers, secretary; James C. Holt, treasurer, and J. P. Hart, manager.

LITTLE ROCK, ARK.—The Long Distance Telephone Company, which was organized to build independent telephone lines throughout the State, has elected officers as follows: W. D. Hearn, of Pine Bluff, president; Charles F. Speed, of Monroe, La., secretary; E. R. Wynne, Bald Knob, treasurer, and E. L. Bracy, of Little Rock, general manager. The capital stock of the company is placed at $300,000.

GRASS VALLEY, CAL.—At the annual meeting of the Clear Creek Telephone Company the following named officers were elected: Samuel Weeks, president; Garfield Robson, vice-president, and F. Schwartz, secretary and treasurer.

CHICAGO, ILL.—At a meeting of the directors of the Western Electric Company two changes were made in the board. H. A. Halligan and J. W. Johnston resigned, and were succeeded by J. I. Waterbury, of New York, N. Y., and W. H. Miner, of Chicago, Ill.

ANDERSON, IND.—At the annual meeting of the Delaware & Madison Counties Telephone Company the following-named officers were elected: George W. Beers, of Fort Wayne, president; W. H. Quick, of Anderson, vice-president; Theodore F. Rose, of Muncie, secretary, and W. E. Hitchcock, of Muncie, treasurer. The company has decided to make large extensions to its system this year.

IDA GROVE, IA.—At the annual meeting of the Ida County Mutual Telephone Company the following-named officers were elected: R. E. Todd, president; J. I. Hess, vice-president; W. C. Forney, secretary, and A. A. Reuch, treasurer.

BLANFORD, MASS.—At the annual meeting of the Farmers' Telephone Company the following named officers were elected: A. L. Lewis, president; Alonzo Barnes, vice-president; James E. Severy, secretary, and J. A. Smithies, treasurer.

NORTHPORT, MICH.—At the annual meeting of the Leelanau Mutual Telephone Company the following-named officers were elected: William J. Thomas, president; Charles B. Kehl, secretary, and James L. Kehl, treasurer.

BARNESTON, NEB.—At the annual meeting of the Farmers' Mutual Telephone Company the following-named officers were elected: D. Starn, president; William Townsend, secretary, and A. Elmen, treasurer.

KEENE, N. H.—At the annual meeting of the Keene Gas & Electric Company the following-named officers were elected: William H. Elliot, president; Wallace L. Mason, vice-president, and George M. Rossman, treasurer.

ALBANY, N. Y.—The directors of the Waterford & Cohoes Railroad Company have elected the following-named officers: L. F. Loree, president; C. S. Simms and W. H. Williams, vice-presidents; J. J. Hagen, secretary; James McCredie, treasurer, and Edgar S. Fassett, general manager.

ELMIRA, N. Y.—At the annual meeting of the New York & Pennsylvania Telephone & Telegraph Company the following named officers were elected: U. N. Bethell, president; H. F. Stevens, vice-president; William J. Farquhar, secretary; W. N. Eastabrook, treasurer; E. Rogers, general manager.

MARIETTA, OHIO.—At the annual meeting of the Marietta Telephone Company the following named officers were elected: A. L. Gracey, president; J. S. H. Torner, vice-president; A. C. Davis, secretary and general manager; W. J. Speer, treasurer; W. W. McMahon, assistant manager.

NEW LEXINGTON, OHIO.—At the annual meeting of the Perry County Telephone Company the following-named officers were elected: P. M. Cullinan, president; George C. Forquer, vice-president; T. M. Potter, secretary and treasurer, and T. H. Wall, general manager.

YOUNGSTOWN, OHIO.—At the annual meeting of the Mahoning & Shenango Railway & Light Company the following named officers were elected: E. N. Sanderson, president; Randall Montgomery and M. E. McCaskey, vice-presidents; Leighton Calkins, secretary, and S. C. Rogers, treasurer.

PORTLAND, ORE.—At the annual meeting of the Pacific States Telephone & Telegraph Company the following-named officers were elected: E. J. Zimmer, president; Louis Glass, vice-president; F. W. Eaton, secretary and treasurer, and J. H. Thatcher, assistant secretary and assistant treasurer.

EBENSBURG, PA.—At the annual meeting of the North Cambria Farmers' Telephone Company the following-named officers were elected: Peter C. S. Strittmatter, president; Otto Anna, secretary; directors: H. M. Gooderman, S. A. Westrick, Dr. H. Somerville, Edward Brawley, James A. Farbaugh and S. A. Ryan, and the officers named above.

MEADVILLE, PA.—At the annual meeting of the Meadville Telephone Company the present officers were re-elected for the ensuing year as follows: W. J. Maddox, president; J. D. Downing, vice-president; H. M. Dickson, secretary, and C. S. Burwell, treasurer.

EAU CLAIRE, WIS.—At the annual meeting of the Ludington Telephone Company the following-named officers were elected: Gust. Roessler, president; Herman Berlin, vice-president, and J. E. Zetzman, treasurer. The directors voted to make several extensions in this county the coming summer.

FOND DU LAC, WIS.—At the annual meeting of the Eastern Wisconsin Railway & Light Company, the Fond du Lac Street Railway & Light Company and the Fond du Lac Gas Company the following named officers were re-elected: N. C. Draper, vice-president and general manager; H. F. Whitcomb, Jr., vice-president and secretary, and W. E. Cole, treasurer.

HAMILTON, ONT.—At the annual meeting of the Dominion Power & Transmission Company the present officers were re-elected as follows: Col. Gibson, president; John Knox and James Dixon, vice-presidents; W. C. Hawkins, secretary and general manager, and John Moodie, treasurer.

New Incorporations.

NORTH SAN JUAN, CAL.—The Northern Power & Water Company has been organized in Nevada County for the purpose of constructing a large power and water system in this section. It is the intention of the company to form a large chain of lakes or reservoirs to carry pure water to the San Francisco Bay cities, to dredge Shady Creek for gold and to build a large dam below Sweetland, below which a hydroelectric power plant will be installed.

HARTFORD, CONN.—Articles of incorporation have been filed with the Secretary of State for the Connecticut Home Telephone Company. The capital stock of the company is placed at $100,000, and the incorporators are L. Lewis Sperry, of Hartford; J. H. Hale, of Glastonbury; R. P. Lyon, of Hartford, and Alembert R. Crosby, of Glastonbury.

CALHOUN, ILL.—The Calhoun Farmers' Co-operative Telephone Company has filed articles of incorporation, with a capital stock of $25,000. The incorporators are: C. D. Hunter, F. F. Bennett, M. H. Barnes and C. Temple.

MOLINE, ILL.—The United Light & Power Company has been incorporated, with a capital stock of $60,000, by W. H. Downing, Edward Burke and others.

TAYLORVILLE, ILL.—The Taylorville Street Railway, Light, Heat & Power Company has been organized for the purpose of constructing an electric railway and power plant in this city. The incorporators are I. J. Perkins, Albert Morgan, J. A. Adams and W. B. Adams, of Taylorville, and Mrs. Alice Moore, of St. Louis, Mo.

ALEXANDRIA, IND.—The Alexandria Telephone Company has been organized, and proposes to construct rural lines in and about Alexandria. Application has been made for a franchise, and it is expected that work on the system will commence at an early date. William Ellsworth is president of the company.

CANAAN, IND.—The citizens of this city have organized an independent telephone company, which will be known as the Canaan Central Telephone Company. The directors of the company are H. C. Woodfill, James Barber, Clarence Shaddy, M. C. O'Neal, T. J. Vanosdol, T. A. Spencer, Lee Flint, P. Vestile, Marcus Taylor and others.

CLARKSVILLE, IND.—The Clarksville Telephone Company has been incorporated, with a capital stock of $1,500. The officers are: B. O. Brattain, president; Harry Layton, secretary, and Harry Lyant, treasurer.

NEW MARION, IND.—The New Marion & Dabney Hollin Telephone Company has filed articles of incorporation with the Secretary of State, with a capital stock of $12,000. Joseph N. Hess, Lawrence Miller and others are directors.

WEST LEBANON, IND.—Articles of incorporation have been filed for the Farmers' & Merchants' Co-operative Telephone Company, with a capital stock of $30,000, by Hugh Brenner, G. W. Day, William White, A. J. Johnson and others.

LA CENTER, KY.—The citizens of La Center have organized an independent telephone company to compete with the East Tennessee Telephone Company. The company is capitalized at $25,000, and the officers are: Dr. T. M. Baker, president; W. H. Viets, vice-president; Samuel McGee, secretary, and John W. Moore, treasurer.

SOUTH PARIS, ME.—Articles of incorporation have been filed for the Citizens' Telephone & Telegraph Company with the Secretary of State, with a capital stock of $10,000. The company proposes to operate telephone and telegraph lines in the towns of Paris and Norway. John F. Plummer is president, and Charles W. Bowker, treasurer, both of South Paris.

EYGLAND, MINN.—The Eygland Telephone Company has been incorporated, with a capital stock of $50,000, by John Logan, Anthon Linden and Gunder Nomland.

PRATT, MINN.—The Pratt Rural Telephone Company has been organized to build a telephone line from Pratt to Owatonna. The officers of the company are W. A. Degner, president; A. J. Thamert, vice-president; G. Thiele, secretary, and L. A. Degner, treasurer.

ST. CLOUD, MINN.—The Le Sauk Telephone Company has been organized to build a rural telephone line. E. S. Clement is secretary.

BLOOMFIELD, MO.—The Bloomfield Electric Light, Heat, Power & Water Company has been incorporated with a capital stock of $10,000 by James B. Buck, Thomas J. Toole, A. D. Wilcox and others.

FREEBURG, MO.—The Drum Hill Telephone Company has been incoroporated, with a capital stock of $1,000, by E. A. Eckert, P. Petri and N. Schlueter.

BIG TIMBER, MONT.—The Northern Telephone Company has been incorporated, with a capital stock of $20,000, by Theodore S. Lavold and others.

MISSOULA, MONT.—Articles of incorporation have been filed for the Grant Creek Telephone Company, with a capital stock of $1,000, by G. O. Phelps, A. C. Hollenbeck, John Richli and Michael Flynn, Sr.

RENO, NEV.—The Malad Power Company has filed articles of incorporation and may compete for local business with the Reno Power, Light & Water Company. The company owns power plants near Sheridan in the Sierra Nevada Mountains, and the directors claim they have sufficient power to furnish the towns of Reno, Carson, Virginia, Dayton, Goldhill, Yerington and Fallon. The incorporators are J. H. Richards, R. E. Cavaney and E. L. Hice, capitalists from Idaho.

THE NATIONAL TELEPHONE RECORDER COMPANY, of New York, N. Y., has been incorporated with a capital stock of $10,000 by Jacques Reiser, Hermaun M. Braun and Laurence Goldberg, all of New York, N. Y.

THE KOZESNIK ELECTRIC THIRD-RAIL COMPANY, of New York, N. Y., has been incorporated with a capital stock of $100,000 by B. Hartman, A. Hartman, C. Kozesnik, of New York, N. Y., and G. A. Harris, of Astoria. The company proposes to manufacture a safety third-rail.

NEW YORK, N. Y.—The F. & M. Illuminating Company has filed articles of incorporation with the Secretary of State with a capital stock of $25,000. The directors are Charles Falkenheim, of Brooklyn; Edmund Magen and Ernest J. Magen, of New York, N. Y.

GENESEO, N. Y.—The C. S. & S. Telephone Company has been incorporated, with a capital stock of $5,000, by C. H. White, E. B. Wilhelm and H. L. May, of Conesus.

PALMYRA, OHIO.—The Palmyra Telephone Company has filed articles of incorporation with a capital stock of $10,000. H. S. Wilson is president of the company and S. A. Church, secretary and treasurer.

EDDYVILLE, OKLA.—The Eddyville Northern Telephone Company has been incorporated with W. T. Woody, president, and James Wolf, secretary. The Eddyville Northwestern Telephone Company has been incorporated with W. J. Lawson, president, and W. O. Porter, secretary, and also the Eddyville Southwestern Telephone Company with A. B. Walter, president, and Charles Wiley, secretary. The village trustees have granted a franchise to the Eddyville Telephone Exchange.

WINTON, PA.—The Winton Electric Company has been incorporated with a capital stock of $5,000. The directors are Grant Pelton, of Scranton, treasurer; William M. Clark, of Carbondale, and Edward S. Jones, of Olyphant.

WORTHINGTON, PA.—The West Penn Telephone Company has been formed to connect Worthington, Sherrett and Montgomeryville. The new line will be built by the Kittanning Telephone Company and will be operated from the local company's office.

FULTON, S. D.—The Fulton & Alexandria Telephone Company has been organized and the following officers elected: Kenneth Brown, president; S. P. Chapman, secretary and treasurer.

WINFRED, S. D.—The Winfred Telephone Company has been organized to install a local telephone system. M. Chapin is secretary.

YORKTOWN, TEX.—The Yorktown Light & Ice Company has been incorporated with a capital stock of $7,500 by Richard Eckhardt, Charles J. Eckhardt and R. J. Motsch. The company has purchased the local electric light plant owned by Koenig & Son, and will make extensive improvements to the system. The price paid for the plant is said to be $20,000.

CEDAR CITY, UTAH.—The Iron County Telephone Company has filed articles of incorporation, with a capital stock of $10,000. The directors are: Henry W. Lunt, Evan E. Williams, Charles S. Wilkinson, George W. Decker, Thomas J. Jones, John G. Pace and William Ford.

CEDAR CITY, UTAH.—Articles of incorporation have been filed for the Iron County Telephone Company with the Secretary of State with a capital stock of $10,000. The directors are Harry W. Lunt, Evan E. Williams, Charles S. Wilkinson, George W. Decker, Thomas J. Jones, John C. Pace and William Ford.

EXCHANGE, W. VA.—The Braxton Citizens' Telephone Company has been incorporated, with a capital stock of $10,000. The incorporators are: E. C. Jones, Lester Gerwig, J. M. Cutlip, W. N. Ditlip, O. F. Floyd, W. A. Bosley, J. T. Lockard and S. S. Shaver, all of Exchange; J. I. Hefner, of Cutlip, and P. H. Murphy, of Cassaway.

ASHLAND, WIS.—The Ashland Power Company has been incorporated, with a capital stock of $100,000, by C. T. Bundy, R. P. Wixcox and I. S. Smith.

FOND DU LAC, WIS.—The Briggs Electric Company has been incorporated, with a capital stock of $15,000, by W. F. Briggs, Albert T. Mellin and A. L. Briggs.

HILLSBORO, WIS.—The Hillsboro Light & Power Company has been incorporated, with a capital stock of $10,000, by Rollin F. Myers and others.

SOLDIERS' GROVE, WIS.—Articles of incorporation have been filed for the Crawford-Vernon Mutual Telephone Company by P. N. Peterson, K. M. Hooverson, A. E. Christenson and others.

BYRON, ONT., CAN.—The Byron Telephone Company has been incorporated, with a capital stock of $15,000.

MILESTONE, SASK., CAN.—The Milestone Southwestern Telephone Company is being organized here to build a line 30 miles long to the southwest of this town to connect with a proposed rural telephone system. Address J. J. Courtnay.

Legal.

ELECTRIC LIGHT RECEIVERSHIP.—Vice-Chancellor Walkner on Feb. 26 appointed Mitchell B. Perkins temporary receiver of the Bordentown Electric Light Company, of Bordentown, N. J., and the Cinnaminson Electric Light Company, of Riverside, N. J. The application for a receiver was made by Whitney & Kemmerer and the Bryan-Marsh Company, of Philadelphia, Pa. It is said that the financial condition which caused the receivership application was caused by their connection with the Camden & Trenton Railway Company, now in the hands of a receiver.

ARMATURE CONSTRUCTION LITIGATION.—The United States Circuit Court of Appeals for the District of New Jersey has sustained an opinion rendered some time ago in favor of the Westinghouse Electric Manufacturing Company, against the Prudential Insurance Company, of New York, restraining the latter from further infringement of the Nolan patent in the use of a direct-current generator manufactured by the Bullock Electric Manufacturing Company. The decision held that claims Nos. 2 and 4 of the Nolan patent are valid and have been infringed. The infringement related to a means for clamping the armature laminæ in place, a split ring partially located in a circumferential groove in the armature spider being used to hold the clamping plate in position, the ring itself being held from centrifugal movement by a shoulder upon the clamping plate.

REDDING, CAL.—An interesting suit is being tried in the Superior Court of this city before Judge Finch. The Battle Creek Power Company, which is owned by the Northern California Power Company, seeks to condemn a reservoir site on ground claimed by the Pacific Power Company. The suit will involve a new point—Can one public service corporation condemn the property of another public service corporation? The Northern California Power Company is building a large dam across Battle Creek for the purpose of creating a storage reservoir and taking water out of the stream at a considerable elevation in the rocky gorge. The dam will be 150 ft. high and will back the water up the creek for miles and completely submerge the power house site of the Pacific Power Company. Can this be done lawfully? The decision in this suit will answer the question.

SACRAMENTO, CAL.—The judgment of the Tehama County Superior Court in the case of W. H. Gurnsey vs. the Northern California Power Company, defendant and appellant, for ejectment, has been reversed by the California Appellate Court. It appears that in October, 1902, the Board of Supervisors of Tehama County gave the power company permission to run its power wires on poles along certain county roads which crossed about two miles of the plaintiff's property. After the wires had been strung Gurnsey brought suit for ejectment and won out in the Tehama County Superior Court. The defendant appealed. The Appellate Court held that a demurrer to the answer of the corporation filed by the plaintiff was not but should have been overruled, and, further, that the lines were for the purpose of promoting the general welfare, and the plaintiff did not claim that he had been injured by their presence.

VISALIA, CAL.—Judge Wallace has handed down a written opinion in the case of A. G. Wishon against the Globe Light & Power Company and others, involving the right to divert a quantity of water from points on Tule River, both being within the Sierra Forest reserve, deciding in favor of defendants and against plaintiff. The points at issue were whether James W. Pursell, predecessor in interest to the Globe Light & Power Company, after first filing his notice of appropriation in Sept. 26, 1902, complied with the requirements of the law subsequent to that time, although he was stopped by Forest Supervisor White on behalf of the federal government, pending a permit to carry on the work. The permit was obtained in July, 1906, and later, in September, the Globe Light & Power Company, which had acquired Bursell's interest, resumed work. A like permit was granted to plaintiff in August. Judge Wallace holds that

defendants have prosecuted the work as required by law with a reasonable diligence. The other point at issue of whether defendants properly posted its notices is also decided in its favor, the court taking judicial notice that the property contained in the description given is located within the Sierra forest reserve.

Personal.

MR. ARTHUR WEST, formerly chief engineer of the Westinghouse Machine Company, severed his connection with that company on Jan. 31.

MR. H. E. CHUBBUCK, of Ottawa, Ill., has been appointed general manager of the Wichita Railroad & Light Company, of Wichita, Kan., succeeding Mr. S. L. Nelson, of Peoria, Ill.

DR. LEE DE FOREST was married Feb. 25 to Miss Nora Stanton Blatch, a granddaughter of Mrs. Elizabeth Cady Stanton. The bride is a graduate from the civil engineering course of Cornell University.

MR. J. S. WEBSTER has, since the completion of his work in preparing plans and specifications for the large Butlers Brothers' building in Minneapolis, had permanent offices at 21 North Sixth Street, Minneapolis, Minn.

MR. ALEC. HENDERSON has been pushing conduit interests in the Pacific, and his friends are in receipt of letters and picture postal cards from Honolulu. As an old globe trotter, Mr. Henderson is quite at home in the Sandwich Islands.

MR. H. ASKIN has resigned his position as superintendent of the Barnes Electric Light & Power Company, of Maquoketa, Iowa, to take effect March 15. Mr. Askin's name is well known in central station circles from his unique and successful new business methods.

CAPTAIN GODFFREY L. CARDEN, U. S. R. M., who is on a mission to Europe from the Department of Commerce and Labor, to report on the machinery situation there with respect to American export trade, has already turned in several reports relating to the machine-tool industry in Prussia.

MR. FORD HUNTINGTON, who has been treasurer of the New York Telephone Company for several years, has been elected permanent treasurer of the New York & New Jersey Telephone Company to succeed Henry Sanger Snow, who has been indicted for misappropriating $148,000 in the stock and bonds of the company.

MR. ARTHUR B. SHEPARD will represent the Electric Machinery Company, of Minneapolis, in northern Ohio, with headquarters at Cleveland. Mr. Shepard has for the past seven years been manager of the Cleveland office of the General Electric Company, and previously was on the engineering staff of that company at Schenectady, N. Y.

MR. MOULTON, for the past six years with the New York office of the Fort Wayne Electric Works, has accepted a position with the Manhattan Electrical Supply Company as special representative. His extended experience in all branches of the electrical business, dating back to 1889, and his large acquaintance with the trade in general, should prove of value to the already efficient staff of the Manhattan company.

MR. F. O. BROILI, superintendent of the Truckee River General Electric Company, of Reno, Nev., resigned his position to take effect on March 1. His position will be filled by Mr. George Campbell, at present manager of the Reno Power, Light & Water Company. Mr. Broili has for the past four years been in charge of the plants along the Truckee, supplying power to the towns of Carson, Virginia, Yerington and Reno.

MR. HERBERT G. LOWELL has been elected manager of the municipal lighting plant of Templeton, Mass. Mr. Lowell, who had an active part in the construction of the plant, was formerly a member of the Manila staff of the J. G. White Company, and has been engaged in electrical engineering work in Canton, China, and Bombay, India, in the latter place, having been connected with the construction of electric railway lines.

DR. G. F. KUNZ.—Dr. George Frederick Kunz, president of the American Scenic and Historical Preservation Society, and connected with the United States Geological Survey, received through the Norwegian Chargé d'Affaires at Washington last week from King Haakon VII. the Cross of the First Class of the Royal Order of St. Olav in recognition of his distinguished services to science in the department of mineralogy. Dr. Kunz is well known in the electrical field, and is a member of the American Society of Mechanical Engineers.

MR. ARTHUR B. LISLE was chosen general manager of the Narragansett Electric Lighting Company, of Providence, on Tuesday, Feb. 25. The office was formerly held by Mr. M. J. Perry, who was also president for many years, but at his resignation the two offices were separated. Mr. Lisle was assistant general manager of the company in 1905, when he resigned. He worked his way up in the company from an office clerkship. He is connected with the banking firm of D. A. Peirce & Company, is a director of several manufacturing interests, and treasurer of the Putnam Light & Power Company, of Putnam, Conn.

MR. F. E. REIDHEAD, who for the past five years has been manager for Stone & Webster, of the Columbus (Ga.) Power Company, has been transferred to the management of the Paducah, Ky., properties of the same company, consisting of the electric railway, central station and gas plants. Mr. Reidhead was formerly general superintendent of the Minneapolis General Electric Company.

MR. JOHN S. BLEECKER has taken charge of the electric light and power, railway and gas properties of Stone & Webster at Columbus, Ga. Previous to this assignment Mr. Bleecker was manager of the Paducah, Ky., properties of the same company.

MR. U. N. BETHEL has been re-elected president, and Mr. Walden Hopkins, secretary of the New Jersey Telephone Company. Mr. Ford Huntington was elected permanent treasurer to succeed Mr. H. S. Snow, now under indictment, and Mr. H. B. Thurber succeeds J. C. Reilly as second vice-president, taking up the duties of that office in addition to those of general manager of the Brooklyn and New York companies. Mr. Reilly will be attached to the president's office. Mr. Walter Brown has been chosen auditor to succeed Mr. J. L. Hamar, who will remain as auditor of the Manhattan company as well. The changes made are in accordance with the plan commenced about two years ago to merge the management of the New York and Brooklyn companies.

Obituary.

MR. WILLIAM HALL HAMMOND, a brother of Mr. John Hays Hammond, the mining engineer, died on Jan. 19, at San Mateo, Cal. Mr. Hammond was a native of San Francisco, 51 years of age. He was president of the Mt. Whitney Power Company, a million-dollar corporation, in which Mr. John Hays Hammond is the controlling owner.

MR. ORRIN S. WERNTZ, treasurer of the National-Acme Manufacturing Company since its organization, died Feb. 6, aged 32. Mr. Werntz was born in Canal Fulton, Ohio, and removed to Cleveland early in life. His first position was with the National Screw & Tack Company, until the organization of the National-Acme Manufacturing Company. His late illness was of about one month's duration, his last visit to the office having been on Jan. 4. A wife and young son survive him.

MR. THOMAS CARSON BARR, for twenty years prominent in street railway circles in New Jersey and a pioneer in electrifying surface roads in Newark, died at his home in Orange, N. J., Feb. 26. Mr. Barr became interested in the street railways of Newark in 1889 and four years later became president. In the early 90's he published the *Newark Times*. He afterwards sold out his interest and later conducted a morning newspaper in Trenton. He was formerly president of the Orange Club, and at the time of his death was a member of the board of governors. He was also a member of the Essex County Club, of West Orange; Union League Club, of Philadelphia, Pa.; Lawyers' Club, of New York; Essex Club, of Newark; Trenton Country Club and the Lotus Club, of Trenton.

Unclassified Items.

SHREVEPORT, LA.—The Shreveport Suburban Railway Company has been chartered with a capital stock of $50,000. John Lorenz is president and J. B. Atkins, secretary and treasurer. The company has already commenced work on the construction of its new electric railway.

COVINGTON, LA.—Preliminary arrangements have been completed for the construction of an electric railway from Covington and Abita Springs to Mandeville, work on construction of which is expected to commence in the near future. E. A. Leonval, of Covington, is interested in the enterprise.

HUNTINGTON PARK, CAL.—Articles of incorporation have been filed for the Huntington Park Gas & Electric Company. The capital stock of the company is placed at $20,000, and the directors are E. B. De Le Matyr, J. J. Curren and H. F. Leukfeld.

NEEDLES, CAL.—Application has been made to the Board of County Supervisors for a franchise to erect transmission lines from the power house of the Victor mines to Needles to supply electricity for lamps in this town.

THE BENJAMIN ELECTRIC MANUFACTURING COMPANY, of 42 West Jackson Boulevard, Chicago, Ill., has been advised that its new No. 903 attachment plug has been passed upon and approved.

MR. ARTHUR B. LISLE has been elected general manager of the Narragansett Electric Lighting Company, of Providence, R. I., to succeed Mr. Marsden J. Perry, resigned. Mr. Lisle was connected with the company for twelve years, and at one time was assistant general manager. About three years ago he retired to enter the firm of D. A. Peirce & Company.

PANAMA, N. Y.—The water power plant of the Panama Power Company was put into operation Jan. 24. The equipment consists of a Leffel turbine operating under a head of 70 feet; a 30-kw, three-phase, 60-cycle, 2200-volt Westinghouse generator. At present the plant furnishes electricity for 300 incandescent lamps. The company contemplates establishing a power service in the spring and will install motors to operate the grist mill, creamery and other concerns. The purchase of another turbine is anticipated in the near future. E. M. Wiltsie is secretary and manager.

VIENNA, S. D.—The Lunde Telephone Company has filed articles of incorporation with a capital stock of $5,000. The incorporators are C. N. Christopherson, A. P. Lunde and Edward E. Peterson.

WOONSOCKET, S. D.—The Warren Telephone Company has been incorporated with a capital stock of $1,500 by J. P. O'Neill, C. W. Hopper, T. J. Raus and W. A. Rummelhart.

SISSETON, S. D.—Articles of incorporation have been filed for the Sisseton Telephone Company with a capital stock of $10,000 by N. T. Axness and Knute Bowe.

NYACK, N. Y.—The Rockland Railroad Company has been granted a franchise by the Board of Trustees to construct and operate a street railroad in and through the village.

GREENVILLE, OHIO.—The City Council has granted a franchise to the Mercer Construction Company to build and operate a street car system in the city. The company has secured the right of way between this city and Mercer and from Mercer to Sharon.

Business Notes.

THE HOBART ELECTRIC COMPANY, of Troy, Ohio, is making arrangements to establish a Western branch in Des Moines, Ia. J. E. Williams will be local manager.

MR. GEORGE P. HUTCHINS has removed his business from 500 Fifth Avenue to 11 West Thirty-second Street, New York, where he is associated with the Homer W. Hedge Company, general advertising agents, and will manage the technical department of the business.

THE WISCONSIN ENGINE COMPANY, Corliss, Wis., manufacturer of Corliss steam engines, gas engines, pumping engines, air and gas compressors, has established a branch office in Atlanta, Ga., with offices and rooms in the Candler Building. Mr. Julius M. Dashiell has been appointed sales manager.

THE WAGNER ELECTRIC'S CANADIAN OFFICE.—The Wagner Electric Manufacturing Company, of St. Louis, has appointed Mr. Alfred Collyer as district manager of Canada sales of the Wagner company, with offices in the Bell Telephone Building at Montreal, Que. Mr. Collyer's title will be sales manager for Canada.

ELECTRIC MACHINERY COMPANY'S CLEVELAND OFFICE.—The Electric Machinery Company, of Minneapolis, Minn., has opened an office at Cleveland, Ohio, which will be in charge of Mr. Arthur B. Shepard, who for the past seven years has been manager of the Cleveland office of the General Electric Company.

THE JACOBSON MACHINE MANUFACTURING COMPANY, of Warren, Pa., has recently established a Southern office at Atlanta, Ga., where there will be carried a full stock of gas and gasoline engines of its manufacture, also a stock of repair parts. The office will be in charge of Mr. C. R. Morrison, who has for some time been traveling representative of the company in the Southern States. The office and storeroom are located at 676 Marietta Street, Atlanta, Ga.

DOSSERT & COMPANY, of New York, have received what is probably the largest order for terminal lugs ever used on a single installation in this country. The material is for use in the wiring of the immense terminal buildings at Cortlandt, Church and Fulton Streets, New York, of the Hudson & Manhattan Railway Company operating the tunnels under the Hudson River which have just been opened to the public. These terminals are of the Dossert solderless type, comprising front connection, back connection, angle and swivel lugs, and range in size from 2,000,000 circ. mils down to No. 4 cable. Part of the order comes from the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., and is for lugs to be used on fuse blocks of the enclosed type. Approximately, 1000 lugs are required for the switchboards and panel boards of the buildings.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

American Electro-Therapeutic Association. Secretary, Dr. Albert C. Geyser, Willis Ave., New York City. Next meeting in September.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, United Engineering Societies Building, 29 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

American Street & Interurban Railway Engineering Association. Secretary, Walter S. Mower, London, Ont.

American Society of Mechanical Engineers. Secretary, Calvin W. Rice, United Engineering Societies Building, 29 West 39th St., New York. Spring meeting, Detroit, Mich., June 23, 24, 25 and 26.

American Society of Municipal Improvements. Secretary, G. W. Tillson, Municipal Building, Brooklyn, N. Y. Next meeting at Atlantic City, N. J., October 13.

American Street & Interurban Railway Association. Secretary, B. V. Swenson, United Engineering Societies Building, 29 West 39th St., New York.

Association of Edison Illuminating Companies. Assistant Secretary, S. E. Mumford, Detroit, Mich.

Association of Electric Lighting Engineers of New England. Secretary, Wells E. Holmes, 308 Washington St., Newton, Mass. Annual meetings held in Boston, third Wednesday in March.

Association of Iron and Steel Electrical Engineers. Secretary, G. H. Winslow, National Tube Company, Pittsburg, Pa.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Room 511, Harvester Building, Chicago. Next meeting, Montreal, Que., June 24, 25 and 26, 1908.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont.

Canadian Street Railway Association. Secretary, Allan H. Royce, 48 King St., W., Toronto, Ont.

Central Electric Railway Association. Secretary, W. F. Mulholland, Indianapolis, Ind.

Colorado Electric Light, Power & Railway Association. Secretary, John F. Dostal, 405 17th St., Denver, Col.

Electric Club of Cleveland. Secretary, Geo. L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

Electrical Contractors' Association of New York State. Secretary, John P. Faure, 77 Water St., Ossining, N. Y.

Electrical Contractors' Association of State of Missouri. Secretary, Charles J. Sutter, 1220 Pine St., St. Louis, Mo.

Electrical Salesmen's Association. Secretary, Francis Raymond, 209 State Street, Room 1002, Chicago. Annual meeting, Chicago, January, each year.

Electrical Trades Association of Canada. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Can.

Electrical Trades Association of Chicago. Secretary, Frederick P. Vose, Marquette Building, Chicago. Next meeting, Chicago, November 5.

Electrical Trades Association of Philadelphia. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Claus Spreckels Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Friday of each month.

Empire State Gas & Electric Association. Secretary, Charles H. B. Chapin, 154 Nassau St., New York. Next meeting in October.

Engine Builders' Association of the United States. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

Illinois State Electric Association. Secretary, H. E. Chubbuck, La Salle, Ill.

Illuminating Engineering Society. Secretary, V. R. Lansingh, 33 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

Independent Electrical Contractors' Association of Greater New York. Secretary, Lewis H. Woods, Imperial Hotel, Broadway and Thirty-Second St., New York.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Detroit, Mich., 1908.

International Independent Telephone Association. Secretary, J. B. Ware, Grand Rapids, Mich.

Iowa Electrical Association. Secretary, W. N. Keiser, Des Moines, Ia. Next meeting at Savery Hotel, Des Moines, Ia., April 22 and 23.

Iowa Independent Telephone Association. Secretary, C. C. Deering, Boone, Ia. Next meeting, Cedar Rapids, Ia., second Tuesday March, 1908.

Iowa Street & Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia. Next meeting at Des Moines, Ia., in April.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan. Next meeting at Pittsburg, Kan., October 8 and 9.

Kentucky Independent Association. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October, each year.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electrical Association. Secretary, A. C. Marshall, Port Huron, Mich.

Minnesota Central Station Men's Association. A. H. Lane, Glencoe, Minn., chairman.

Missouri Independent Telephone Association. Secretary, G. W. Schweer, Windsor, Mo. Next meeting, Kansas City, May 6 and 7.

Missouri Electric Light, Gas & Street Railway Association. Secretary, C. Z. Pierson, St. Charles, Mo. Next meeting at Marquette Hotel, St. Louis, April 23, 24 and 25.

National Arm, Pin & Bracket Association. Secretary, J. B. Magers, Madison, Ind.

National Electric Light Association. Secretary, W. W. Freeman, Brooklyn Edison Company, Brooklyn, N. Y. Headquarters, 33 West 39th St., New York. Next meeting at Chicago, May 19, 20, 21 and 22, 1908.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 94 Genesee St., Utica, N. Y. Next meeting at Chicago, July 15.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago. Next meeting at Philadelphia, June 11.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, William Bradford, Lincoln, Neb. Next meeting, Omaha, May 4 to 9.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 33 West 39th St., New York.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. M. Eaton, Niagara Falls, N. Y.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, Roger N. Kimball, Kenosha, Wis. Next meeting, Milwaukee, January, 1909.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Aug. 25, 26 and 27, 1908.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Columbus, Ohio. Next meeting, Columbus, March 19.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL & STEAM ENGINEERS. Secretary, F. W. Ballard, 104 Canal St., Cleveland, Ohio. Next meeting at Columbus, May 15 and 16.

OKLAHOMA ELECTRIC LIGHT, RAILWAY & GAS ASSOCIATION. Secretary, Charles W. Ford, Oklahoma City, Okla.

OLD TIME TELEGRAPHERS' & HISTORICAL ASSOCIATION. Secretary, John Brant, 195 Broadway, New York. Next meeting, Niagara Falls.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 136 South Second St., Philadelphia, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Col. Meeting second Saturday of each month.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

SOUTH DAKOTA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. R. Buck, Hudson, S. D. Next meeting at Yankton, S. D., January 13 and 14.

SOUTHWESTERN ELECTRICAL & GAS ASSOCIATION. Secretary, R. B. Stichter, Dallas, Tex. Next meeting at El Paso, Texas, in March.

STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA. Secretary, E. M. White, Box 345, Hartford, Conn.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, J. H. Pardee, Canandaigua, N. Y.

VERMONT & NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. B. Seeley, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury, Vt.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION. Secretary, Electrical Committee, C. M. Goddard, 55 Kilby St., Boston, Mass. Next meeting, March, 1908.

WESTERN SOCIETY OF ENGINEERS. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1 each year.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED FEB. 25, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

879,885. INTERLOCKING RELAY; Edward McClintock, St. Paul, Minn. App. filed April 30, 1907. Has a relay mechanism whereby a signal will be operated when the train is moving in one direction but will be silent or inoperative when the train is moving in the opposite direction.

879,886. HIGHWAY CROSSING SIGNAL FOR ELECTRIC ROADS; Edward McClintock, St. Paul, Minn. App filed April 30, 1907. Relates to modifications of the above particularly adapted for use at a crossing.

879,887. METHOD FOR REGULATING ELECTRIC GENERATORS; George S. Neeley, St. Louis, Mo. App. filed May 9, 1907. Means for automatically regulating the field density of an electric generator, providing a constant voltage in the work circuit by an arrangement of magnets which controls the field resistance by a differential action.

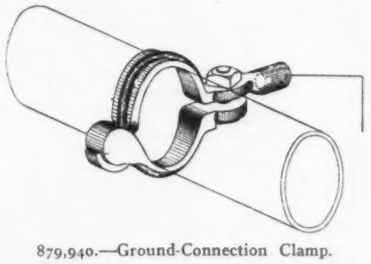
879,859. APPARATUS FOR PRODUCING VERY THIN SHEET METAL; Thomas A. Edison, Llewellyn Park, Orange, N. J. App. filed March 1, 1905. Apparatus for producing thin metallic strips or films, comprising in combination an electro-deposition bath, a cathode in said bath formed of copper-aluminum alloy in which the percentage of copper largely predominates, and an anode arranged adjacent to said cathode, substantially as set forth.

879,927. POLE SHOE FOR DYNAMO ELECTRIC MACHINES; Robert B. Treat, Newark, N. J. App. filed April 9, 1906. A form of construction for the tips of pole shoes designed to prevent crowding of the lines of magnetic force therein and resultant displacement of the field. The pole tips have an elongated perforation inclined to the face of the pole shoe at the tips thereof.

879,940. GROUND-CONNECTION CLAMP; William H. Blood., Jr., Wellesley, Mass. App. filed March 23, 1905. Clamp designed to engage a pipe with the greatest possible conducting efficiency so as to carry away comparatively heavy currents therefrom.

879,943. TROLLEY POLE SUPPORT; James L. Chase, Ayer, Mass. App. filed Aug. 23, 1907. Patentee has a weighted arm raising the trolley pole through a gear segment and means for tripping the rack from the gear to retrieve the pole when the latter leaves the wire.

879,949. COIL RETAINER FOR DYNAMO ELECTRIC MACHINES; Gano Dunn, East Orange, N. J. App. filed June 3, 1907. The armature slots have undercut grooves near their outer edges, in which are received small plates or blocks which are inserted by a rotary movement by the means of a suitable tool, instead of being slid longitudinally into place.



879,940.—Ground-Connection Clamp.

880,011. DYNAMO ELECTRIC MACHINE; Henry Chitty, Strand, London, England. App. filed June 2, 1904. A means for controlling the field density at the pole piece of an electric generator. The pole has a perforation of trapezoidal section extending therethrough at the region of its normally densest field, and an iron bridging piece extends from this point to the next adjacent pole of the generator.

880,020. VAULT LINING; Jacob L. Grass, Minneapolis, Minn. App. filed July 13, 1907. Patentee provides plates held on the interior of a safe or vault by especial circuit closing devices so as to actuate an alarm in case the bolts are tampered with in any way.

880,021. TROLLEY; George H. Gross, Binghamton, N. Y. App. filed April 26, 1906. In place of the usual bearing, patentee has a fixed grooved ring over which a trolley wheel of ring-shaped or annular form is positioned to rotate.

880,027. METHOD OF MAKING ELECTRODES; Ernest W. Junger, Kneippbaden, Sweden. App. filed Apr. 4, 1907. The method of producing electroactive substances for secondary batteries which comprises binding small particles of magnetic metal by a hydrate of one of these metals, and taking certain other steps specified.

880,037. METHOD OF TREATING GASES AND GAS MIXTURES BY MEANS OF VOLTAIC ARCS; Albert J. Petersson, Alby, Sweden. App. filed Aug. 23, 1904. The method of treating gases by means of voltaic arcs, which consists in leading gases through a furnace chamber, creating the said arcs between electrodes in the said furnace chamber, and creating electrodynamic forces by means of electric currents of greater intensity than that of the current creating the arcs for displacing the latter, substantially as and for the purpose set forth.

880,044. TRANSMITTER; Samuel W. Rothermel, New York, N. Y. App. filed Jan. 5, 1906. A typewriter transmitter having a continuously rotating toothed cylinder with which gears having cams are adapted to be lowered selectively by depression of the keys.

880,046. HIGH-FREQUENCY DISCHARGE APPARATUS; James E. Seeley, Los Angeles, Cal. App. filed Nov. 26, 1906. A means for producing high-frequency electrical discharges by the use of either alternating or direct current. Has induction means for producing the discharge which will operate as a tranformer on alternating currents to supply energy by induction from the supply line to the charging circuit.

880,055. ARC-LIGHT ELECTRODE CONTAINING METAL WITHIN THE SAME; Hermann Viertel, Charlottenburg, Germany. App. filed April 16, 1907. A method of manufacturing arc light electrodes, consisting of filling the interstices of a reticulated metal tube with core material and inserting said tube into a hollow carbon casing and drying the same.

880,072. RAILWAY SIGNAL APPARATUS; Frank Graziano, New Orleans, La. App. filed June 15, 1907. Has a track apparatus comprising a grating with spaced bars and terminals arranged below the upper surface of the grating and adapted to form parts of normally open electric circuits which are completed by tappets depending from the cars and passing between the gratings.

880,079. RADIATOR; George Hodgdon, Wilkinsburg, Pa. App. filed June 8, 1907. A radiator of substantially the ordinary outward appearance and containing water which is heated by resistance coils.

880,107. ELECTRIC TROLLEY; Leonard Smith, North Tonawanda, N. Y. App. filed Dec. 9, 1905. The trolley harp is pivoted to the upper end of the pole and has a limited movement at such point by virtue of a spring and bolt connection.

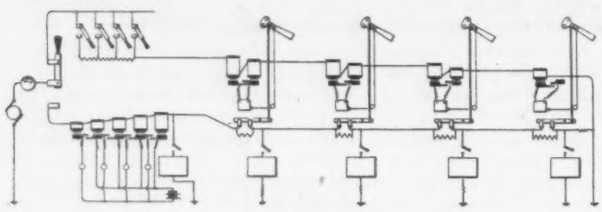
880,121. ELECTRICAL INSULATOR; Daniel G. Bolton, Camden, N. J. App. filed Nov. 23, 1906. An electric insulator comprising a pin, disks thereon spaced apart, and a sleeve or bushing of flexible insulating material around the pin between the disks.

880,134. ALARM SIGNAL MECHANISM; Ellsworth E. Flora and Robert J. Zorge, Chicago, Ill. App. filed June 19, 1907. Means for giving warning to an engineer or motorman of the opening of a switch or draw. Includes an apparatus alongside the track rails for positioning a torpedo thereon in case the train approaches when the switch is open.

880,136. SIGNAL SYSTEM; Julian A. Gehrung, New York, N. Y. App. filed Feb. 2, 1907. Provides a signal system particularly adapted to suit the requirements of railroad traffic in rural and undeveloped sections of the country. Secures a complete semaphore control of

the railroad line under the surveillance of the despatcher at a city terminus and provides for telegraphic communication to the train at whatever point of the line it may be. This is accomplished by two wires or conductors extending along the roadway. There is further provided a means to give an indication or check on the accuracy of the system so that any conditions such as broken wires, short circuited wires or leakage, or any other defect is at once notified to the despatcher's office.

880,152. ELECTRIC SIGNAL FOR ELEVATORS; Charles E. Moore, Los Angeles, Cal. App. filed March 7, 1906. Relates to signals displayed in an elevator cage and provides an efficient signal which



880,136.—Signal System.

will disclose to the operator in charge of the cage as soon as a passenger on a floor decides to go either up or down. Includes complete electrical and mechanical features.

880,160. BURGLAR ALARM SYSTEM AND APPARATUS THEREFOR. Milton R. Ney and Samuel S. Ullman, Washington, D. C. App. filed Sept. 25, 1907. Patentee insets in the door jamb a depressible plunger which co-operates with a telephone circuit so as to give an alarm thereon when the door is open.

880,167. COMBINED LOCK AND ELECTRIC SWITCH. William M. Shannon and George K. Taylor, Columbia, S. C. Relates to a door lock switch for electric lights by means of which the lighting circuits in a room controlled by the door will be opened or disconnected when the person last leaving the room closes the door after having first thrown on the dead latch to prevent the door being opened from the outside except by a proper key.

880,196. BATTERY; Frank A. Decker, Philadelphia, Pa. App. filed March 21, 1904. The combination of a conduit, a socket intersecting said conduit, a tube extending into said socket, and a nut engaging said tube and having a passage therein through which said tube and conduit communicate, substantially as specified.

880,168. COMBINED LOCK AND ELECTRIC SWITCH; William M. Shannon and George K. Taylor, Columbia, S. C. App. filed Aug. 22, 1907. Relates to modifications of the above.

880,203. INSULATOR; John D. E. Duncan, Brooklyn, N. Y. App. filed Sept. 9, 1907. Compound petticoated insulator for high potential currents having an arcing ring incorporated therewith.

880,209. ELECTRICALLY OPERATED CLOCK; Harleigh Gillette, Chicago, Ill. App. filed March 27, 1907. Relates to complete escapement action of a secondary clock which is operated by the intermittent energization of an electromagnet.

880,218. SIGNAL MECHANISM FOR BLOCK SIGNAL SYSTEMS; Harry L. Johnson, Topeka, Kans. App. filed April 2, 1907. Signal mechanism for electric block signal systems having a main battery to alternately energize primary or main and secondary electromagnets; has a local battery and a local electromagnet signal circuit and connections whereby the making of the circuit through the main battery shall complete the local and signal circuits successively.

880,266. ELECTROMAGNETIC CLUTCH; Heinrich Ast, Vienna, Austria-Hungary. App. filed June 15, 1906. Patentee has two disk or iron-clad magnets operating face to face with an independently rotatable element therebetween having a passage for the circulation of a cooling medium.

880,271. METHOD OF FORMING RAIL BONDS, ETC.; Eugene M. Bournonville, Jersey City, N. J. App. filed Sept. 20, 1907. The method of connecting rails and other metal bodies comprising heating the metal of the parts to be connected to a point short of the melting point, then increasing the temperature of one of said parts until a portion thereof melts and becomes unified with the heated portion of the other part.

880,272. THERMO ELECTRICAL SYSTEM; William H. Bristol, New York, N. Y. App. filed Nov. 11, 1907. Provides a thermostatic apparatus which is designed to indicate sudden changes of temperature but which is unresponsive to gradual changes.

880,320. RAILWAY SIGNALING SYSTEM; Wilmer W. Salmon, Rochester, N. Y. App. filed July 3, 1907. Block signal system having sectionally energized track rails connected by inductive bonds and which are used as return conductors for the power current. The blocks are sectionally energized by alternating currents which are short circuited to operate the signals.

880,338. ELECTRIC-ARC FURNACE; Sidney D. Spence, Chattanooga, Tenn. App. filed Dec. 17, 1906. An electric-arc furnace having vertically adjustable inner electrodes, side electrodes, pivotally mounted longitudinally adjustable arms carrying said side electrodes and means to raise and lower said arms and hence also said side electrodes.

880,367. BATTERY; Frank A. Decker, Philadalphia, Pa. App. filed May 9, 1905. In a battery, a cell having a base with a set of interior depressions therein, an exterior conducting strip, conducting screws passing through said strip and base into the respective depressions, and electrodes within said cells having depending parts disposed in said depressions.

880,368. BATTERY; Frank A. Decker, Philadelphia, Pa. App. filed March 21, 1904. In an electrochemical apparatus, a plate having overlapping indentations in its opposite sides, substantially as specified.

880,373. PROCESS OF ACCELERATING THE SEPARATION OF NITROGLYCERIN FROM ACIDS; Richard Escales and Milano Novak, Munich, Germany. App. filed Sept. 5, 1907. The process of separating nitroglycerin from mixed acids, which consists in passing an electric current between electrodes through a liquid mixture of acids and nitroglycerin.

880,395. TROLLEY WHEEL SPRING; Ralph E. Noble, Chicago, Ill. App. filed July 3, 1907. The harp has arms with longitudinal recesses therein, which recesses receive the looped portions of blade springs interposed between the wheel and the arms of the harp to establish good electrical contact.

880,398. ELECTROMECHANICAL SLOT FOR SIGNALS; George S. Pflasterer, Nashville, Tenn. App filed Aug. 29, 1907. Signal operating mechanism of the "electromechanical slot" type for use on railways in which a signal set for safety or clear is through the intermediary of electrically controlled appliances shifted upon the reversal of the normal condition of the electric circuit in which the governing magnet is included.

880,405. PROCESS FOR PRODUCING PORELESS AND WELL-ADHERING ELECTRODEPOSITS; Harry Schmidt, Cologne, Germany. App. filed Aug. 7, 1907. The process of producing poreless and well-adhering electrodeposits, which consists in first providing the metal to be electroplated with a coating of a metal or alloy which melts at a lower temperature than the final electrodeposit.

880,416. WIRE-SUSPENDING DEVICE; Herbert E. Stevens, Macdonaldton, Pa. App. filed Nov. 9, 1906. The cross arm of the pole is recessed vertically from its under face so as to receive a pair of co-operating wedge elements which together form a cup. One of the wedge elements has a lug to which the depending insulator is fixed so that the weight thereof constantly tightens said wedges in their recess.

880,418. INSULATOR FOR HIGH-TENSION CONDUCTORS; Samuel H. Summerscales, Winnipeg, Manitoba, Canada. App. filed Nov. 23, 1906. Provides a pyramidal vitreous block with horizontal grooves on its side faces in which various conductors are supported.

880,420. STORAGE BATTERY PLATE; Alfred O. Tate, Toronto, Canada. App. filed Dec. 1, 1905. A bifunctional storage battery plate embracing a series of narrow strip-like anodes and a series of intervening cathodes of similar structure; in combination with layers of porous insulating media between said anodes and cathodes and conducting binding means at each end of the plate constituting respectively the plus and minus poles thereof, substantially as described.

880,421. STORAGE BATTERY PLATE; Alfred O. Tate, Toronto, Canada. App filed Oct. 29, 1907. A bifunctional storage battery plate, embracing anode and cathode strips of ribbons, and intermediate porous insulating strips grooved on their opposite faces; in combination with active material located in said grooves and prevented thereby from being released, substantially as described.

880,422. STORAGE BATTERY PLATE; Alfred O. Tate, Toronto, Canada. App. filed July 3, 1907. A bifunctional storage battery plate composed of interleaved strip of ribbon-like anodes and cathodes sustained at their lateral edges by insulating frames, substantially as described.

880,423. STORAGE BATTERY PLATE; Alfred O. Tate, Toronto, Canada. App. filed Oct. 29, 1907. A bifunctional storage battery plate, embracing elements comprising anode and cathode strips and interleaved porous insulating media; in combination with porous retaining plates adapted to be held against the edges of said elements, substantially as described.

880,424. STORAGE BATTERY PLATE; Alfred O. Tate, Toronto, Canada. App. filed Oct. 29, 1907. A bifunctional storage battery plate, embracing a rigid base provided with grooves on its opposite faces and anode and cathode strips located in said grooves in definite or fixed relation to each other, substantially as described.

880,425. STORAGE BATTERY PLATE; Alfred O. Tate, Toronto, Canada. App. filed Oct. 29, 1907. A bifunctional storage battery embracing anode and cathode strips sustained in grooves on the exterior faces of a hollow base plate provided with liquid conveying openings from the central opening of the base plate, substantially as described.

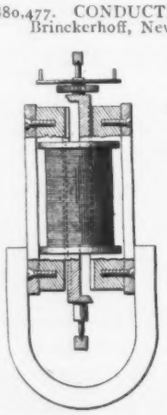
880,429. COIL RETAINER FOR DYNAMO ELECTRIC MACHINES; Robert B. Treat, Newark, N. J. App. filed Nov. 12, 1907. The slots of the armature are undercut at their edges to receive small resilient plates which are sprung into place.

880,435. ELECTRIC ARC LAMP; Thomas E. Adams, Cleveland, O. App. filed Aug. 11, 1905. A construction of cap or cover for the arc-enclosing globe designed to provide a simple and efficient means for prolonging the life of the carbons.

880,437. BRUSH HOLDER; Albert Ball, Claremont, N. H. App. filed Nov. 30, 1906. A brush holder of the ring type which is engaged upon the field frame by circumferentially disposed lamping devices.

880,464. APPARATUS FOR TREATING GASES AND GAS MIXTURES BY MEANS OF VOLTAIC ARCS; Albert J. Petersson, Alby, Sweden. App. filed Sept. 6, 1905. In an apparatus for treating gases by means of voltaic arcs, the combination of a furnace chamber, electrodes extending in the same general direction in the said furnace chamber, a source of electric current connected to the said electrodes for creating the said arcs between the latter, and means for creating electrodynamic forces for strengthening the displacing action on the arcs exerted by the currents flowing through the electrodes to the said arcs, substantially as and for the purpose set forth.

880,477. CONDUCTING CONDUIT FOR VEHICLES; Francis M. Brinckerhoff, New York, N. Y. App. filed March 12, 1907. Patentee has tubular passages in the car roof extending down through the pivots of the bogy trucks into the castings of the motors so as to cool the same.



880,485. — Magneto-Electric Inductor.

880,484. PROCESS OF PRODUCING VERY THIN SHEET METAL; Thomas A. Edison, Llewellyn Park, Orange, N. J. App. filed June 29, 1904. An improved process for producing metallic sheets or foils, which consists in electrolytically depositing a thin metal film on a polished surface of an aluminum-copper bar of suitable form extending through the coil, and means to rotate the bar to close the magnetic circuit between diagonally opposite poles, substantially as described.

880,485. MAGNETO-ELECTRIC INDUCTOR; Martin Fischer, Zurich, Switzerland. App. filed July 5, 1900. Electric generators of the type having a permanent magnet with an armature between its poles and arranged to close the magnetic circuit, and consisting of a soft iron core carrying an induction coil in combination with means for controlling the direction of the magnetic flux with relation to the coil.

880,489. PROCESS OF PRODUCING MAGNESIUM; Franz von Kugelgen, et al., Halcombs Rock, Va. App. filed June 9, 1905. The process of producing magnetism by dissolving magnesium oxid in a fused bath of magnesium fluorid and one or more fluorids of metals more electro-positive than magnesium, and subjecting the same to electrolysis.